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ABSTRACT

This administrative and instructional guide offers information and recommendations for computer design techniques based on literature sources and school district applications; design of micro- and mini-computer systems is intended for those with little or no experience. Chapter 1, "Planning for the Computer System: Choosing Purposes and Parts," deals with selecting inputs, including strategic and tactical plans, a feasibility study, data and material inputs, and the marketplace. "Designing a Logical Structure for the Computer System: Establishing Organization," chapter 2, discusses comprehensive and integrated computer systems, integrating system subsystems, and internal and external user support subsystems. Chapter 3, "Designing Effective Processes for the Computer System: Determining Outputs and Dealing with Constraints," presents information on effectiveness, security, software piracy, and equal access. "Designing Efficient Processes for the Computer System: Implementing the Computer System," chapter 4, discusses developing a change plan, a timetable, support, and training programs. Chapter 5, "Evaluating the Computer System: Providing for Feedback and Adaptation," analyzes environmental change, system stress, and ongoing planning. "Synthesis of the Model," chapter 6, forms a concise design guide. The final chapter offers conclusions and future implications. Eight appendices provide forms for school use, an annotated bibliography, and selected school district references. (CJH)

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A COMPREHENSIVE MODEL FOR THE DESIGN OF MICRO AND MINI COMPUTER SYSTEMS IN SCHOOL DISTRICTS

A GUIDE FOR DEVELOPING COMPUTER SYSTEMS FOR LOCAL SCHOOL DISTRICTS

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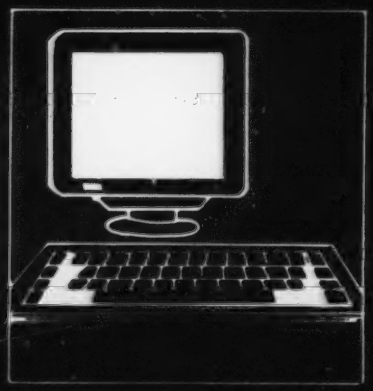

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A handbook developed from a detailed and comprehensive 1985 study of the nation's 100 most successful systems

Based on a review of the literature in school computer system design and an analysis of the responses from participating school districts

By
SANDRA L. GRACZYK
and
CHESTER KISER

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PREFACE

This guide was developed from a detailed and comprehensive 1985 doctoral dissertation study, which examined computer system design techniques found in the literature and the field.

Relevant literature was reviewed to gather information on all topics which could be included in a macroscopic model for computer system design. Because there were no holistic models of this nature existing in the literature, a wide search was necessary. The result was a preliminary set of design criteria that provided a skeleton and starting point for the study's model. This preliminary set of design criteria was then refined by the results of the field research.

The field research helped determine which concepts and practices were actually being used by practitioners to plan and implement in-house computer systems. In order to obtain input from designers of efficient and effective computer systems, a nomination process was used. Nominators from across the nation were asked to submit names of school districts that were considered outstanding for the design or use of their computer systems. The nominator group consisted of the researcher's dissertation committee, the study's panel of experts (a group of eight individuals listed in Appendix A who were knowledgeable about education and computers), individuals suggested by the dissertation committee and the panel of ex-

perts, state presidents of the Association of Educational Data Systems (AEDS), selected state presidents and executive directors of the Association of School Business Officials (ASBO), and names culled from the literature. Seventy-two nominators from twenty-six states across the nation responded to the request for names of school districts; this was 60.5% of those contacted. This resulted in 75 school districts nominated for their outstanding administrative computer systems and 50 school districts nominated for their outstanding instructional computer systems.

These school districts were then sent questionnaires to determine which design concepts and practices they had found useful. One hundred school districts across the nation -- 80% of those contacted -- responded to the survey.

Finally, twenty-four school district respondents were interviewed by telephone. The purpose of these interviews was three-fold: (1) to augument knowledge of promising concepts and practices; (2) to obtain clarification of issues not resolved by survey results; (3) to enrich model development.

Draft versions of the model were then critiqued by the dissertation committee and the panel of experts, and their suggestions were incorporated into the final version of the model.

The result of these efforts is a comprehensive model containing concepts and practices that educational administrators can use to guide the planning and implementation of micro and

mini computer systems in their school districts.

A comprehensive work such as this cannot be accomplished alone. This researcher owes a great deal to many. First, I would like to thank my co-author and friend, Professor Chester Kiser of the Department of Educational Organization, Administration and Policy of the State University of New York (SUNY) at Buffalo. As chair of the dissertation committee, his expertise proved invaluable to every phase of the study. Also, appreciation is extended to the dissertation committee, composed of SUNY at Buffalo Professors Marjorie K. Hanson and Robert W. Heller of the Department of Educational Organization, Administration and Policy, and C. Alan Riedesel, of the Department of Learning and Instruction. Their commitment to excellence helped create a worthy product. Next, members of the panel of experts gave freely of their time and their ideas to enrich the study. Heartfelt gratitude also goes to the editor of this publication, Dr. Bruce Brummitt, Executive Director of the New York State Association of School Business Officials. His interest in this project from its inception to its completion has helped turn an idea into a reality. Last but not least, I express loving appreciation to my parents, Brown and Clara Graczyk. Their unwavering support and help as word processors and production assistants has helped make this book possible.

S. L. Graczyk
June 1, 1986

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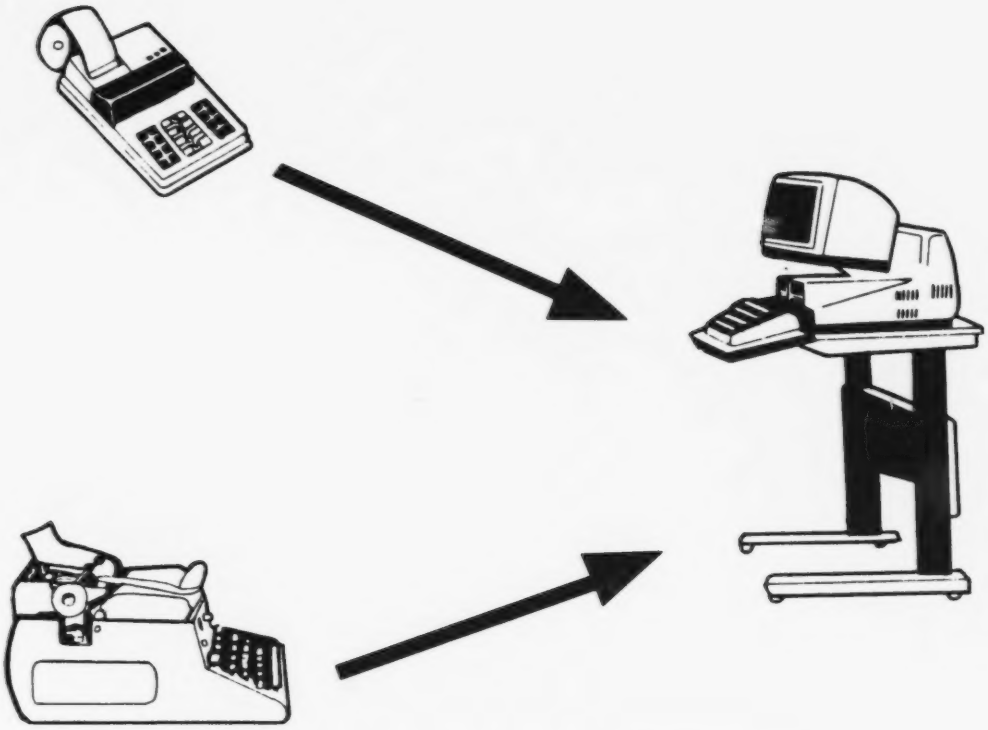

INTRODUCTION

INTRODUCTION

The Electronic Revolution has produced new and powerful tools which have become pervasive in our society, creating opportunities to accomplish old tasks in new, more efficient ways. This has increased pressure to emplace computer systems in school districts; however, educational administrators have discovered that designing in-house computer systems is no easy task.

Prior to the invention of micro and mini computers, many school districts joined educational computing consortia, which use mainframe computers to provide electronic data processing services. Many administrators felt that their districts lacked sufficient workloads, financial strength, and/or trained personnel to purchase their own mainframes. Moreover, the decision process was simplified under this arrangement. School districts had a dichotomous choice: to join a computing consortium or to continue manual operations. With the advent of inexpensive yet powerful micros and minis, many school districts began acquiring their own computers to process data; however, school administrators have discovered that designing their own computer systems is not as easy a task as simply purchasing services from a consortium.

A comprehensive conceptual and operational model for designing computer systems in school districts may help educators in the field cope with what must sometimes appear to

be irrational and chaotic inputs. There are many factors that can make the design process very confusing: rapid advances in the field of computer technology, vendors eager to make a sale, advice from too many sources, and countless brands of hardware and software. Because this study's model makes the process of computer system selection and implementation more orderly and systematic, the model can guide school administrators in carrying out appropriate school district activities for adaptation and growth in response to the new technologies. Since this research incorporates information about the actual design experiences of school districts, educational administrators can use the model to avoid initial mistakes and trial-and-error methods that cost time and money. A more efficient and effective design process can lead to better use of the resources allocated to computer system development.

This study focuses on the design of micro and mini computer systems, rather than mainframe computer systems; therefore, throughout this publication, the terms "computer," "computer system," etc. refer to micro and mini computers unless otherwise stated. Also, this research is limited to in-house computer systems, as opposed to services purchased from an educational computing consortium. The model can be used to design computer systems for both instructional and administrative applications because its scope is not limited to specific data processing applications or selected aspects of computer system design. There are many commonalities to designing

administrative and instructional computer systems; however, where there are differences, the model provides the appropriate design concepts and practices for each type of computer system. Also, the model is comprehensive in nature: It considers all phases of the design process and all systems within a school district that may be affected by a new or improved computer system.

The model is meant as a guide for those with little or no design or computing experience. It forms a step-by step process for those administrators who are contemplating the emplacement of computer systems in their districts. Therefore, the model is composed of concepts that are necessary or useful for the successful design of school district computer systems. These concepts are concretized with related practices. Selected practices are illustrated with techniques and forms which the designer can use. Topics in the model are arranged in a preferred action sequence: Computer system designers are urged to complete the design tasks in the same order as presented in the model. However, those who are uninitiated in the world of computing may find it helpful to first read "An Introduction to Computers" found in Appendix B.

The model is divided into five major chapters, as illustrated in Figure 1. Chapter 1 deals with the strategic planning activities necessary to select inputs to a computer system. Chapters 2-5 focus on tactical planning activities for achieving efficient processes, effective outputs, and feedback

mechanisms. A synthesis of the model, which forms a concise design guide, is presented in Chapter 6. Finally, Chapter 7 offers some concluding remarks and future design implications.

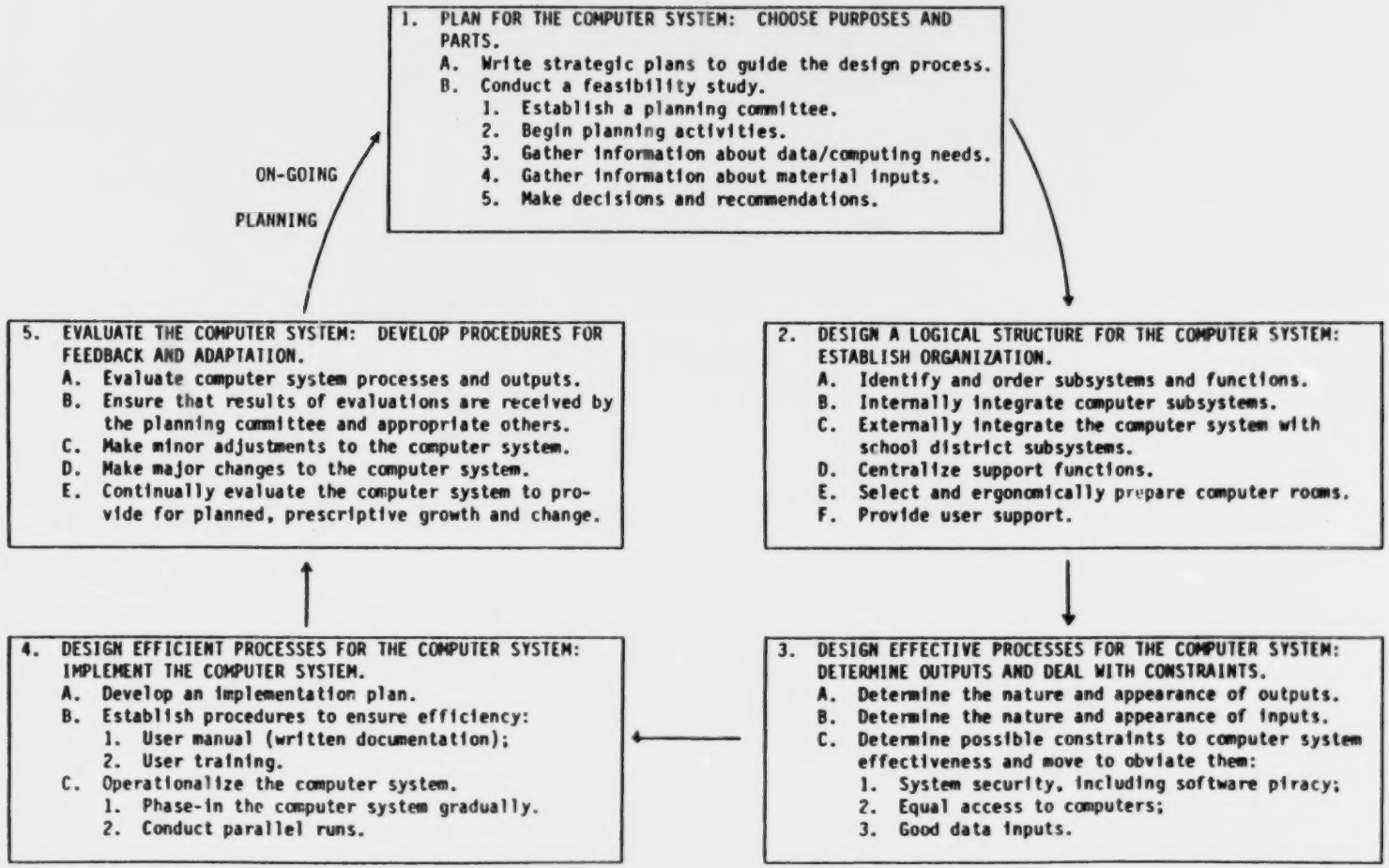
1. PLAN FOR THE COMPUTER SYSTEM: CHOOSE PURPOSES AND PARTS.
A. Write strategic plans to guide the design process.
B. Conduct a feasibility study.
1. Establish a planning committee.
2. Begin planning activities.
3. Gather information about data/computing needs.
4. Gather information about material inputs.
5. Make decisions and recommendations.
ON-GOING PLANNING
2. DESIGN A LOGICAL STRUCTURE FOR THE COMPUTER SYSTEM: ESTABLISH ORGANIZATION.
A. Identify and order subsystems and functions.
B. Internally integrate computer subsystems.
C. Externally integrate the computer system with school district subsystems.
D. Centralize support functions.
E. Select and ergonomically prepare computer rooms.
F. Provide user support.
3. DESIGN EFFECTIVE PROCESSES FOR THE COMPUTER SYSTEM: DETERMINE OUTPUTS AND DEAL WITH CONSTRAINTS.
A. Determine the nature and appearance of outputs.
B. Determine the nature and appearance of inputs.
C. Determine possible constraints to computer system effectiveness and move to obviate them:
1. System security, including software piracy;
2. Equal access to computers;
3. Good data inputs.
4. DESIGN EFFICIENT PROCESSES FOR THE COMPUTER SYSTEM: IMPLEMENT THE COMPUTER SYSTEM.
A. Develop an implementation plan.
B. Establish procedures to ensure efficiency:
1. User manual (written documentation);
2. User training.
C. Operationalize the computer system.
1. Phase-in the computer system gradually.
2. Conduct parallel runs.
5. EVALUATE THE COMPUTER SYSTEM: DEVELOP PROCEDURES FOR FEEDBACK AND ADAPTATION.
A. Evaluate computer system processes and outputs.
B. Ensure that results of evaluations are received by the planning committee and appropriate others.
C. Make minor adjustments to the computer system.
D. Make major changes to the computer system.
E. Continually evaluate the computer system to provide for planned, prescriptive growth and change.

Figure 1. Overview of the Comprehensive Model for the design of Computer Systems in School Districts

CHAPTER 1

Planning For The Computer System: Choosing Purposes And Parts

CHAPTER I

PLANNING FOR THE COMPUTER SYSTEM:

CHOOSING PURPOSES AND PARTS

THE PURPOSES OF PLANNING

Planning is of paramount importance in the process of selecting and implementing a computer system. Written, multi-year plans should be followed to guide the design process and to ensure that thought and preparation precede action.

There are several advantages to starting the computer system design process with the formation of plans:

1. **Planning helps focus and direct the remainder of the design process,** thereby encouraging proaction, rather than reaction;

2. **Planning helps bring order out of chaos.** The world of electronic technology is very dynamic and can be confusing to the uninitiated. Planning helps designers make informed choices about inputs to a computer system;

3. **Planning aids the formation of specific objectives and intended outcomes** for the computer system. These objectives are useful during both the design process and actual system operation;

4. **Planning facilitates user acceptance** of a new computer system;

5. **Planning encourages efficient expenditures,** rather than haphazard purchases.

PLANNING TECHNIQUES

When planning a computer system, it is important to have a macroscopic perspective. This means using a systems approach and considering the functional integration of various

subsystems of the computer system and the relationship between the computer system and the other departments of the school district. This broad view guards against conflicts of interest: It helps ensure that the various divisions of the computer system work in harmony and that the computer system complements, rather than conflicts with, other school district operations.

The best plans are worthless unless they are followed. Plans are action guides, and as such, are meant to direct design activities. Furthermore, plans should be followed in their original form, making only minor modifications that may be necessary from time to time. Plans lack continuity -- and cannot guide actions -- if they are continually changed. This underscores the need for plans that are developed with thought and care during the early stages of the design process.

COMPOSITION OF THE WRITTEN PLAN

A written plan for designing a computer system should consist of both strategic and tactical components. Strategic plans focus on determining the need for a computer system and how that need can best be met. Tactical plans guide the implementation of the chosen computer system.

Below is a list of the strategic and tactical components of a plan for designing a computer system. It is appropriate at this point to discuss in detail certain of these components. They will also be illustrated by documents and examp-

les. Planning elements only briefly mentioned here will be presented in depth elsewhere in the model.

Strategic Plans

The written documents generated during strategic planning are meant to be used by a computer system planning committee as decision aids and action guides. These documents also form part of the report of the committee's findings to the superintendent and the board of education at the conclusion of the strategic planning phase.

The first two steps in strategic planning -- delineation of the problem and determination of its scope -- should be done before any other planning activities take place. This focuses initial planning efforts and helps determine who will join the design process. At this point, however, these two planning elements can be accomplished by those who first felt a need for a computer system, perhaps management and the board of education. The definition and scope of the problem can be revised later by others who join the planning process.

The strategic parts of the design plan should include:

1. **Definition and description of the planning problem.** The area under consideration -- designing a computer system -- should be discussed and put into writing so that everyone involved with the project now and in the future understands its nature;

2. **Scope of the plan.** Planners should determine the answers to several questions. For example, should an instructional computer system be designed for all schools in the district or only for the elementary grades; should an administrative computer system have only financial applications or process all data of interest to management;

3. Statement of top management support;

4. Tentative schedule of activities;

5. Provisions for training of committee members;

6. Assumptions;

7. Planning philosophies;

8. Needs;

9. Goals and objectives (intended outputs and applications);

10. Recommendations for material inputs to the computer system: software, hardware, peripherals, furniture, supplies, and housing;

11. Computer system budget;

12. Brief summary of the strategic plan.

Tactical Plans

The tactical parts of the design plan should include:

1. An implementation plan for operationalizing the computer system;

2. Written documents to support the computer system (user manual);

3. Staffing requirements;

4. Plans for providing user training;

5. Provisions for feedback on computer system operations and outputs.

THE FEASIBILITY STUDY:

THE CORNERSTONE OF STRATEGIC PLANNING

The feasibility study is the foundation of the strategic plan because it helps determine the computing needs of the district and the ways in which those needs can be met.

A feasibility study should be conducted before any tac-

tical plans are made. By weighing the anticipated benefits of a new computer system against its estimated costs, planners can decide to continue with the implementation stage or abandon the project before a major investment in time and money has been made. A feasibility study helps avoid common planning mistakes such as lack of focus, estimation errors, over-optimism, and lack of management support. The feasibility study is also the process by which the elements of the strategic plan are developed.

During a computer system feasibility study, information is gathered about three main types of inputs to a computer system: people, data, and materials. This information is then carefully analyzed to provide answers to three questions about a proposed, new computer system:

1. Is it technically possible?
2. Is it economically feasible?
3. Is it practical for the district?

The People Inputs

It is essential to have a formal committee or other organized group of people to plan and design the computer system. The planning committee should be actively involved in all phases of computer system design, from forming assumptions during the feasibility study to evaluating the implemented computer system and suggesting changes.

Because of the committee's involvement in the design process from beginning to end and beyond, the committee should be

on-going rather than finite in duration. Also, the committee should report its findings directly to the superintendent of schools. Keeping the chief school officer informed is one way to garner management support, which is crucial to the success of the design process. Furthermore, by being responsible to the top, the development of the computer system can be free from undue influence of and possible ownership by any one segment of the school. Finally, reporting to the superintendent legitimizes the committee's work: The design project must be important if the committee reports directly to the chief school officer, rather than a deputy or designee.

Composition of the Planning Committee

The planning committee should be composed of anticipated users of the proposed computer system. The grass roots ideas generated and refined during committee meetings are invaluable for successful computer system design. Moreover, involving users in the design process will help promote acceptance of a new computer system if it is implemented because users will feel a sense of ownership of the system. Finally, the input of those most likely to be affected by a new computer system can help ensure a macroscopic and comprehensive planning scope.

The major criteria for participation on the planning committee should be membership in a group of potential users of a computer system and knowledge of the school district and its computing needs. The planning committee should include central office administrators: the school business administrator

for an administrative computer system and the assistant superintendent for curriculum/instruction for an instructional computer system. Building principals should also be included on the planning committee. The use of consultants is optional. If the committee feels the need for expert advice, it can be provided by a knowledgeable staff person or a consultant, who can sit on the committee on either a full-time or an ad hoc basis. Expert opinion may be needed more by planners of administrative computer systems than instructional computer systems because of the often complex, technical nature of administrative computer systems and their hardware and software. Care must be taken, however, when using consultants, especially those called upon to lend technical advice. Their advice may overwhelm planners and blind them to what should be their most important concern -- the needs of the district and the users. It should be noted, too, that micro and mini computers are designed to be user-friendly and operable by existing staff members who may have little or no computing background. Therefore, the assistance of a technologically-sophisticated expert may not be necessary, unless the committee feels a strong need to understand the functional intricacies of computers.

The planning committee should not include students, members of the board of education, or vendors. Students are not likely users of an administrative computer system; while they are undoubtedly the beneficiaries of an instructional computer

system, they are not the ones most knowledgeable of curricular needs which can best be met by a computer system. The same rationale applies to members of the board of education: They are seldom direct users of a computer system. The board may receive financial reports generated by a computer system, but they are not likely to be the ones who will design these reports or know the data processing needs of the district. Furthermore, the proper role of a board of education is one of policy-making -- and by extension, approval of the design plan submitted by the committee -- not directly designing or implementing a computer system. Vendors are not good candidates for the planning committee for obvious reasons: They may make recommendations based upon their own needs -- sales -- rather than the needs of the district. It may be best not to include the superintendent of schools as a regular member of the planning committee. He or she may not wish to participate because of time constraints. More importantly, though, the presence of the chief school officer may unduly influence the committee's decisions.

A committee planning for an administrative computer system should also include representatives from potential user groups such as secretaries and data processing professionals. The planning committee for this type of computer system typically does not include teachers or other citizens from the community, because they are usually not direct users of this type of computer system.

The planning committee for an instructional computer system should have as its members those who will most use a computer system -- teachers. It may also be appropriate to include representatives from other user groups, such as department heads or university personnel. Community representatives are optional for inclusion on this committee. If they can provide useful insights into the design process or lend technical assistance, they can be invited to participate on a regular or temporary basis. District residents may also be able to provide information about anticipated community reaction to a computer system and taxpayer support or lack of it. Moreover, if these community residents are parents, they can provide input on what they perceive to be the instructional needs for their children and their current efforts at home computing.

Table 1 summarizes the preferred composition of a computer system planning committee for either administration or instruction.

Choosing Committee Members

Members can be chosen by a "selected nomination" process A district-wide pool of possible committee members can be obtained by soliciting nominations from the staff; staff members can also nominate themselves. In this manner, the names of those who want to participate will surface, along with those recognized by their peers as interested in this area. Then, the early initiators of this planning project -- perhaps the

superintendent or other central office administrators -- can choose a representative sample to serve on the committee.

TYPE OF COMMITTEE MEMBER	SHOULD PARTICIPATE IN THE PLANNING COMMITTEE FOR AN:	
	ADMIN. COMPUTER SYSTEM	INST. COMPUTER SYSTEM
Central office administrators	X	X
Building principals	X	X
Consultants/experts	X (optional)	X (optional)
Secretaries	X	
Data processing professionals	X	
Teachers		X
Community representatives/parents		X (optional)

Table 1. Preferred Composition of a Computer System Planning Committee

A written invitation-to-participate should be sent to those selected. To help ensure that prospective committee members understand their role in the planning process, the letter should describe the type of computer system being planned (administrative or instructional), the general composition of the planning committee, and the functions of the committee, which are:

1. **To provide leadership**, direction, and project coordination for both the near and far future;

2. To secure the support of the board of education and top-level management;

3. To identify those assumptions and philosophies of the school district which will affect planning;

4. To identify the needs of potential users of a computer system;

5. To formulate appropriate goals and objectives for an anticipated computer system;

6. To make cost-effective decisions;

7. To foster acceptance and adoption of the computer system by users;

8. To ensure timely implementation of the computer system;

9. To ensure that the computer system meets the needs for which it was designed;

10. To keep informed all those with a need-to-know.

Preliminary Planning Activities

There are certain tasks the committee should undertake upon first convening. A planning committee chair should be designated. He or she may become the computer system coordinator if the computer system is implemented; however, at this point in the design process this individual, acting as the committee's representative, has ultimate responsibility for the coordination and supervision of strategic planning activities and the formation of tactical plans. The committee should then decide on a regular meeting schedule and should agree to follow conventional meeting practices, such as recording notes, for which a permanent recorder should be appointed, following an agenda, and sending committee members

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appropriate written materials prior to each meeting. Also, the concept of division of labor should be used throughout the design process. There will be a great deal of information needed by the committee for informed decision-making. Subcommittees can be formed to gather this information and to perform other planning tasks; however, subcommittees should always report their results to the entire committee, so that all members can be well-informed and have a macroscopic planning perspective.

Once consensus has been reached on these preliminaries, the committee should develop a plan-to-plan, which can guide the remainder of their planning activities. This plan-to-plan should include five elements: (1) a statement of top management support; (2) provisions for training of committee members; (3) a statement of assumptions underlying planning; (4) a statement of planning philosophies; and (5) a tentative schedule of activities. These parts of a plan-to-plan are discussed in more detail below.

Statement of top management support. Support of top-level administration and the board of education is essential for successful computer system design. Management support must start with the encouragement of initial planning efforts and continue with excitement over implementation and interest in daily operations of the computer system. Official support of the computer system is also a key factor in promoting staff acceptance of the system. It is important during early plan-

ning stages to secure a written statement of the superintendent's commitment to the computer design project. This acts as a concrete manifestation of management support of the computer project and can also be a source of new ideas to the committee.

The committee should also encourage management support in other ways, such as:

1. **Adequate allocation of funds** for the computer system;
2. **Cooperation with proposed schedules** for planning committee meetings, training sessions, and user group meetings;
3. **Attendance at user training sessions;**
4. **Encouragement of staff members** to use the new computer system;
5. **Everyday use of the computer system.** This would most likely apply to administrative computer systems; however, top management could show its support of an instructional computer system by being familiar with and occasionally trying some of the computer programs used in the classroom.

A tentative schedule of planning activities. A preliminary schedule of planning activities and data flow should be established. This schedule may undergo revisions as the planning process unfolds; however, by establishing a calendar at this point, the committee can retain a macroscopic perspective of the design process, while better understanding the tasks to be accomplished and their deadlines for completion.

Provisions for training of committee members. Committee members should learn the basics of electronic technology in general and educational computing in particular. A star-

ting point for those with little or no computing background can be the reading of "An Introduction to Computers" found in Appendix B. Training methods can continue with other written materials, courses, and conventions, and should involve some hands-on experience. It may also be very helpful for committee members to visit actual computer installations at similar school districts. During these visits, they can talk with both planners and users of computer systems and can observe the systems in operation. These visits can aid the design process by:

1. Suggesting to committee members possible computer applications for their own district;

2. Helping the committee avoid the mistakes of their colleagues in other school districts;

3. Giving the committee early knowledge of regional factors which must be taken into account during the planning process. These factors can include requirements of the state education department for reporting data or local conditions in weather or geography which can interfere with computer operations, service of equipment, or availability of parts.

A form such as that found in Appendix C can be used to guide the observations and organize the information gathered during the visits.

It is important that computer system designers become familiar with electronic technology and know the strengths and limitations of computers. To do this, the planning committee should learn about these aspects of a computer system:

1. Computer software and what it can do. The committee should be aware of the three sources of software -- custom-made, "off-the-shelf", and "off-the-shelf"

software which has been customized -- and the four types of applications for which computers can be used in schools -- computer assisted instruction (CAI), computer managed instruction (CMI), computer assisted administration (CAA), and computer assisted office work (CAO);

2. **Computer hardware** and how it works. This includes the ability to define such terms as microprocessor, RAM, and ROM;

3. **Peripherals.** Committee members should know about a variety of peripherals, including touch-sensitive screens, light beam pens, keyboards, graphics tablets, speech synthesizers, printers, monitors, teleprinters, disk drives, hard disks, and modems;

4. **Electronic arrangements for computer systems,** how they work, and the strengths and weaknesses of each. These configurations include stand-alone units, local area networks, distributed data processing, and remote area data processing.

Information about the various computer terms discussed above can be consolidated into a list of definitions, which eventually can be incorporated into the set of written documents that support the computer system.

A statement of assumptions underlying planning. Assumptions are statements about the school district and/or its environment -- especially the technological environment -- which the committee acknowledges to be true. These assumptions should be formed early during the planning process because they become the foundation upon which other design activities are based. To help avoid erroneous assumptions which can render a plan ineffective and useless, there should be consensus on any assumptions made by the committee.

A statement of planning philosophies. Planning philos-

ophies are a direct outgrowth of the assumptions previously stated. Philosophies are principles in which the committee believes and which will guide the remaining activities. Philosophies are different than goals and objectives. Philosophies guide the conduct and decisions of the committee; goals and objectives guide the composition and performance of the computer system.

The Data Inputs

The next planning activity involves gathering information about the types of data the proposed computer system will process. This is the first and most important step toward determining the need for a computer system and the components of such a system. To obtain information about the data inputs to a proposed computer system, the committee should determine the information needs of the district. These needs can be translated into system goals and objectives, which can then be used to establish specifications for selecting computer system materials.

Assessing Needs

An analysis of the school district's information needs helps planners answer two questions: (1) Is a computer system needed at this time; and (2) What can a computer system be used for? The task of determining needs is a crucial step in the design process, because if a computer system is implemented, its success will depend on how well it meets those needs.

It is important that committee members understand cur-

rent school district operations and the problems unique to educational data. To do this, planners should examine the ways in which teaching and/or management tasks have been, are currently, and will be accomplished. The committee should look for strengths and weaknesses in the current system and applications which can benefit from computerization. However, planners should guard against tunnel-vision when determining information needs. The design of many computer systems is based on long-standing manual practices or antiquated computer systems; no imagination is used! Designers should not limit themselves to computerizing current practices. Since today's computers are able to do a multitude of tasks in a variety of effective and efficient ways, the planning committee should consider new and exciting applications -- perhaps a different format for reporting data or a new instructional technique -- processes that may not be currently in use in the school district.

A needs assessment should be comprehensive. Input should be sought from all potential users of a computer system, along with information about school district characteristics and environmental factors, such as future trends in the electronic industry and present and anticipated government regulations concerning data reporting or curricula. The needs assessment should also be future-oriented to ensure a long life of utility for the computer system. Many districts project needs on a three- or five-year basis. It is sometimes difficult for

people to identify their long-range needs; however, planners should push to obtain this information because it is essential to the success of the computer system.

Below are some sources of information about data needs in a school district:

1. **Interviews** with potential users of a computer system;

2. **Written surveys** of potential users of a computer system;

3. **Planning committee members**, who represent various user factions;

4. **Examination of written procedures, documents, and records.** It may be helpful at this point to assemble written examples of the inputs, processes, and outputs of the current system. These documents can help the committee better understand the current system and can be used to compare old methods with computerized applications;

5. **Observation** of current procedures;

6. **Outside resources**, such as books, professional publications, professional computing association conferences, other school districts, and outside experts. Information obtained from these sources should be interpreted with caution, however, because it may be situation-specific. Applications computerized in other organizations may not be appropriate for the planners' school district. Furthermore, the committee should ensure that the recommendations of outside experts, who are often vendors, constitute a true needs assessment and not a sales pitch. Any intended applications from the above sources should be tested with potential users in the school district to determine if they meet the needs of that district.

Written surveys of potential users can be particularly useful in assessing information needs. It gives users an opportunity to directly contribute to the design of the computer system and will give them a feeling of ownership and foster

acceptance of the system if it is implemented. The results of the survey can provide the committee with a concrete starting point for needs assessment which can be further refined by the other sources of information listed above.

Appendix D contains two forms -- one for administrative applications and one for instructional applications -- that can be used to assess computing needs.

Assessing needs for administrative computer systems. To determine information needs for an administrative computer system, it is helpful to examine the types of decisions made by management and the information needed to make those decisions. It is also important to look at past, present, and future data needs. Planners should ask themselves the following questions to assess data needs for an administrative computer system:

1. What kinds of jobs will be done?
2. How many different applications does that involve?
3. How great will the volume of data be?
4. How will back-ups of the data be made?
5. Who will input the data and how? How many terminals will be needed?

Tasks that are currently performed in an inefficient manner may also suggest data needs. Indicators of this may include large amounts of paper, high clerical costs, repetitive functions, use of bookkeeping machines, and user dissatisfaction with the present system.

Assessing data needs for instructional computer systems. To determine data needs for instructional computing, the subject areas and audiences should be targeted. This information can be used by the committee to ensure that applications are appropriate to a particular course and its students. Computers can be used to enhance the present teaching-learning process by introducing new methodologies or subject matter.

Establishing Goals and Objectives

The next step in planning should be the establishment of written long-range goals and short-range objectives for the computer system. These goals and objectives should be based on the committee's previous work: statements of assumptions and philosophies and results of the needs assessment. Goals and objectives should reflect the intended outcomes of the computer system. They should complement, not conflict with, other goals and objectives of the school district.

It is important to write goals and objectives during the early stages of planning because they can aid future design activities by:

1. Guiding design efforts;

2. Limiting the scope of the design project. Because of resource limitations, it may not be possible to accomplish all desired goals and objectives; therefore, it may be necessary to prioritize them into multi-year stages. This is very important because an over-ambitious plan can lead to failure of the design project and/or the computer system. The success of the committee and the computer system will be judged by the system's performance, not by what was planned or what is projected for the future. It is important, therefore, to choose goals and objectives that are

attainable and to relegate other, more ambitious plans to future years;

3. **Forming benchmarks** by which the efforts of the planning committee and the performance of the computer system can be measured.

The Material Inputs

The remainder of the feasibility study focuses on the selection of computer system components -- hardware, software, peripherals, and supplies -- and the vendors who furnish them. This involves four steps:

1. **Development of specifications** for the selection of software, hardware, peripherals, and vendors;
2. **Investigation of the various offerings** in the market place;
3. **Analysis of alternatives** and selection of software, hardware, peripherals, and vendors;
4. **Development of a computer system budget**, including investment and recurring costs.

Each of these steps is discussed in greater detail below.

Development of Specifications

Explicit specifications of required attributes should be written for the selection of software, hardware, peripherals, and vendors. These specifications can be used as selection criteria to compare the various brands of materials. They should be based upon the results of the needs assessment and the goals and objectives developed earlier in the planning process. It may be necessary to prioritize the selection criteria. It is unlikely that all specifications can be met; therefore, it is important to determine which ones are criti-

cal, so that products which at least meet mandatory specifications are chosen.

There are two general caveats for establishing material specifications. The first is that the specifications should be based on functions, not characteristics. This means that selection criteria should reflect performance standards -- standards that ensure that the material inputs can do the tasks that will be required of the computer system to meet its goals and objectives. Secondly, the specifications should be future-oriented to allow for the growth of the system. The majority of changes made to an existing computer system involve upgrading various components to take advantage of new technological advances. Therefore, the hardware, software, and peripherals selected should have the ability to be expanded, allowing for improvement, rather than obsolescence, of the computer system.

Three other issues that are important for developing specifications are computer system configuration, standardization, and price.

Computer system configuration. There are four possible electronic arrangements for the computer system: stand-alone units, local area networks, distributed data processing, and remote area data processing. It is important for the planning committee to tentatively choose a configuration, because this will affect some of the specifications for hardware, software, peripherals, and vendors. For example, software specifica-

tions can be affected because networked units can support different applications than can stand-alone units, and different applications require different software. The decision to have some kind of networking arrangement can affect other specifications as well. With a network, software can be shared among units. Are there undue copyright restrictions against doing this? Are the hardware operating systems compatible so that the units can "talk" to each other? If printers are shared via a network, should the district acquire fewer, but more expensive printers? Does the vendor know enough about networking to provide support? If distributed data processing or remote area data processing is used, will the host computer have adequate data processing and storage capacity?

It is recommended that planners of administrative computer systems consider some form of networking, preferably distributed data processing (DDP). DDP offers the advantages of both centralization of data storage and decentralization of data processing. District data files can be stored in one central location on the district host computer. Each user site can input data to the central data bank and, using predefined programs stored on the host computer, receive standard output reports from it. Furthermore, each user site can download data from the central data bank to floppy diskettes and manipulate the data to satisfy individual needs. However, downloading and manipulating files should never affect the information stored in the master data bank. Independent manipu-

lation of data at user sites is for internal use only; the results of such data processing are not to be stored in the host computer. This would lead to district-wide confusion because data records would not be uniform in content or format.

Distributed data processing (DDP) is especially appropriate for school districts with buildings scattered over a large geographic area; users need not come to a central location to add data to or retrieve data from district records. The biggest disadvantage to DDP is that independent micros cannot communicate with each other. However, some of this need is eliminated with DDP because of the easy availability of the same information to everyone.

There are, however, other factors which can affect the configuration decision for administrative computer systems. A state education department may have requirements for data transfer and storage. This may affect the decision to network and the type of network. Also, the geographic size of the district and the distance between component schools may also determine the type of electronic configuration.

Stand-alone units can meet most of the needs of instructional computer systems. Students using computers for either programming or CAI are working independently and have no need to communicate with other micros. However, some local area networking may be desirable, especially for computer managed instruction. Also, remote area data processing can be used by students or staff to access information from public data

banks.

The planning committee need not be limited to choosing one electronic configuration. There can be several different configurations developed within the same computer system to meet different data processing needs.

Standardization of materials. Planners should also decide which materials, if any, should be standardized in brand throughout the computer system.

For administrative computer systems, standardization is optional; it should be done if it meets the data processing needs of the district. It is highly recommended, however, that all computers be of the same make. This provides compatibility of operating systems, which allows for easy software and data transfer, either electronically or by sharing floppy disks. Standardized hardware also provides a built-in backup system, which is essential for applications such as payroll. Standardization of software is optional. It is desirable, but not necessary to standardize on brand for peripherals; it makes user training easier because users need not learn many different sets of operating procedures for different brands of equipment. However, many peripherals are not hardware-dependent and can interface with a great variety of machines, so it may be unnecessary to standardize. Moreover, different makes of peripherals have different functions. For example, a dot-matrix printer may be chosen for high-volume in-house reports where speed is important but print appearance is not.

However, a letter-quality printer is necessary for external reports where output appearance, not volume, is the key factor. It is unnecessary to standardize on computer system supplies, and it is very undesirable to standardize on computer furniture. The reason for non-standard furniture is user comfort, which can vary from person to person. Also, furniture specifications are dependent on room conditions, such as size and layout. One brand of furniture may not be appropriate for all locations. Selection criteria for furniture can be affected by computer system application. A secretary doing word-processing may want a work station that has space for a computer, a printer, reference materials, supplies, and files. However, an input station in a remote area data processing net work may simply consist of a chair for the user and a table to hold the terminal.

For instructional computer systems, it is desirable but not necessary to standardize hardware. Students and teachers need only learn how to operate one brand of machine. However, it may be wise to select several brands of micros, depending on application. In this way, cheaper micros can be used for simple CAI exercises, while higher-powered machines can be used for word-processing or advanced programming classes. Standardization of software is optional. Having the same brand of peripherals throughout the computer system is desirable, but not necessary. It is not necessary to standardize on supplies. Standardization of computer furniture may not be

as good an ergonomic practice for instructional systems as for administrative systems.

Price. Should price be considered in developing specifications? The answer depends upon the anticipated source and quantity of funds available to support the computer system. Certainly the cheapest materials are not always the best; however, disregarding price can be detrimental to the acceptance of the committee's recommendations by top management and the board of education. Thus, the planning committee should consider various financial and political factors before making a decision to incorporate a price ceiling into the specifications.

The next sections will discuss in greater detail selection criteria for software, hardware, peripherals, and vendors. The ideas presented constitute only a partial list of specifications. The planning committee should develop additional selection criteria based on goals and objectives specific to the proposed computer system.

Software specifications. Software contains the programs that instruct the hardware and peripherals to produce a desired output. The development of software specifications is an essential element in the process of computer system design. Since software is hardware-dependent, it is necessary to first decide on selection criteria for computer programs. Only then can specifications be developed for hardware, peripherals, and vendors. Good software is essential for user acceptance of

the computer system. Nothing frustrates a person faster than poorly written or inadequate software.

The following are recommended selection criteria for either administrative or instructional software:

1. **Meets the needs of the users.** For administrative computer systems, programs should be powerful enough to manipulate data for desired outputs. Instructional software should incorporate suitable learning theories and use positive reinforcement; it should also meet the curricular objectives for which it was chosen and should be appropriate for the grade level and ability of the students who will use it;

2. **Is user-friendly.** Software should be easy to operate and understand. Displays on the screen should be easy to read. Programs should have "help menus," which provide basic directions for users. User-friendly software should have pre-defined defaults, simple commands, and prompts and interactive questions. Programs should be tolerant of user errors; this allows users to work with minimal supervision. Software should be free of programming mistakes. The pace of the program should be user-controlled. This is particularly important for CAI software, where presentation of a lesson too quickly may frustrate some learners, while a slow pace may bore others. Also, instructional software should be interactive, interesting, and motivating;

3. **Is versatile and flexible.** Computer programs should be flexible to accommodate variations in individual users' skill levels. The software should also allow new applications to be computerized in addition to those initially implemented. This is particularly important for administrative computer systems, whose applications tend to grow over time;

4. **Is currently available in the marketplace.** It is foolish to choose software whose debut is forthcoming, regardless of how outstanding the program may appear. It is essential to select only software which is readily available and easy to obtain;

5. **Can be pre-viewed and operated prior to purchase;**

6. **Has good software documentation** to aid the user in operating the program;

7. **Makes full and appropriate use of the computer's capabilities, especially for instructional software, where graphics and sound are used as motivational tools;**

8. **Has copy protection laws which are not unduly restrictive, especially for software which will be shared throughout a network;**

9. **Has provisions for warranties, corrections, and new version updates.**

Hardware specifications. Hardware is a general term referring to the electrical, electronic, mechanical, and magnetic components of a computer; hardware is the "box" that comes to mind when one thinks of a computer. The most important selection criterion for hardware is its ability to run the programs that the district is considering purchasing. The hardware should have an operating system compatible with the software and enough internal memory to run the chosen programs. For instructional computer systems, hardware need not be "state-of-the-art" to fulfill the district's needs. Very often, older models or less powerful and therefore cheaper versions may be suitable for certain student applications.

Other selection criteria for computer system hardware include the following:

1. **Capacity for system expansion and upgrading.** Changes made to existing computer systems often involve hardware upgrades. Therefore, hardware should be purchased that can be expanded and made more powerful by the addition of new chips. This is particularly applicable to administrative computer systems;

2. **Flexibility.** Hardware should be capable of performing multiple functions;

3. **Networking capabilities.** The hardware chosen should

be capable of being networked with mainframes, other minis or micros, or peripherals. Even if the planning committee decides to start with stand-alone units, networking capabilities are important; many computer systems start with stand-alones and progress to some form of networking;

4. **Features to meet the needs of the users.** Users may need such features as graphics, color, or sound;
5. **Ready availability in the marketplace;**
6. **Provisions for pre-testing and operating prior to purchase;**
7. **Good record of operation, maintenance, and repair;**
8. **Aesthetically pleasing and practical construction;**
9. **Ease of operation;**
10. **Satisfaction of local, regional, and/or state specifications.**

Peripheral specifications. Peripherals consist of equipment external to a computer which provide it with outside communication; examples of peripherals include monitors, keyboards, printers, and hard disks. It is important to establish specifications for choosing peripherals. It will be necessary to develop different specifications for each type of peripheral considered; however, these selection criteria should be based on the peripheral's ability to:

1. **Meet user requirements**, including user comfort and data processing needs;
2. **Be compatible with software and hardware;**
3. **Be readily available in the marketplace;**
4. **Be pre-tested and operated prior to purchase.**

For peripherals which will receive extended periods of

human contact, it is very important to include ergonomic considerations in the specifications. This means that peripherals such as keyboards and monitors should be comfortable to use. For example, keyboards should be in a neutral color with a matte finish and should have concave keys. Monitors should be large enough to produce adequately-sized characters. To further minimize eye strain, these characters should be green or amber on a black background.

Vendor specifications. It is desirable to develop vendor specifications, but because of legal constraints on purchasing procedures for school districts, it may be possible to put only quantifiable selection criteria in an invitation to bid on computer system materials. Other vendor specifications can be used when the award of a contract need not go to the lowest bidder. Vendor selection is important, however, especially for software and hardware, because of the service and support sales people can offer. Selection criteria for vendors can include:

1. A good reputation for product support and service, including user training where appropriate;
2. Financial stability and a two- to three-year history of existence;
3. Provisions for on-site maintenance and repair of products;
5. Provisions for initial installation of products;
6. An adequate supply of products to ensure delivery in a timely fashion;
7. Good treatment of potential and actual customers;

8. **A knowledgeable and helpful sales staff;**

9. **A supply of demonstrators** that prospective customers can try;

10. **An understanding of the educational setting** and the needs of school districts.

Investigation of Various Offerings in the Marketplace

There are many brands of software, hardware, peripherals, supplies -- and vendors to supply these products -- available in the marketplace. The planning committee should gather information on these different options to determine which products and vendors best meet the selection criteria. There are several ways to do this:

1. **Check references.** The committee should find out which school districts are using the same products they are considering purchasing. This can be done by asking vendors for a list of references or by calling local school districts and asking them what they use. References need not be limited to school districts; firms in the private sector can be contacted, too, although talking with other school district users may uncover problems with the product unique to an educational setting. Committee members should talk with, and preferably visit, these on-site installations. These visits are more comprehensive and seek more detailed information than the orientation visits made by the planning committee during initial planning stages;

2. **Observe the product in action and try using it.** This can be accomplished by visiting the vendor's site or by having the vendor bring the product to the school district. Some vendors will even leave the product at school for a few days so that many users can try it. User opinion of a product can be the most valid source of information because these individuals can best determine if the product meets their needs;

3. **Develop requests for proposals (RFPs)** which can be sent to selected vendors;

4. **Use other sources,** such as computer books and maga-

zines, professional publications, and conferences.

Analysis of Alternatives and Selection of Materials

Specifications have been developed and information has been gathered on various materials that may comprise the computer system. Now, the committee's task is to compare the various alternatives and make some tentative decisions.

Any brands of software, hardware, peripherals, or vendors which do not meet mandatory selection criteria should be immediately eliminated from consideration. This may result in a number of alternatives still remaining. These choices can be narrowed through formal decision-making techniques, such as the Product Analysis Chart found in Appendix E.

The following are additional factors to consider when choosing software, hardware, peripherals, and vendors.

Software selection. Software must be selected prior to the selection of any other components of the computer system. Committee members should pre-test and evaluate all those programs which meet the software selection criteria. The Product Evaluation Chart can be used to help analyze and select software. Special forms for evaluating software can also be used, such as those found in Appendix F. Summaries of evaluations or copies of the reviewers' forms for software that is purchased can then be included in the collection of written system documents to help users choose the software best suited to a particular application.

Although "off-the-shelf" software tends to be the choice

of many users, school districts need not be limited by what is commercially available. Software can also be custom-written for the district or developed in-house. Some school districts even sell the programs they write, which is not only a source of revenue for the district, but also a source of pride among users and programmers.

For administrative systems, software developed by school district programmers permits greater flexibility and more user control because it is easier to accommodate users' requests for new applications or changes. As with "off-the-shelf" programs, this software should first address those administrative applications that will meet the district's most pressing data processing needs. Modification of the programs should begin only after the software is implemented and the applications are operating as originally planned. For instructional software written in-house, curricular objectives defined by teachers should guide software development, and not vice versa as is often the case with mass-produced programs.

It is important to note, however, that there are many good programs available "off-the-shelf." School districts should not spend large amounts of time and money developing software in-house if satisfactory programs can be obtained from vendors. The decision to develop programs in-house should be made only if that alternative best meets the needs of the district.

Hardware selection. Hardware should be chosen that can

operate the software that was selected. This fact alone may eliminate some hardware alternatives. Whatever brand is selected, enough units should be purchased to fulfill the district's computing objectives. This is applicable not only to administrative computer systems, where users must have adequate computer access for inputing and processing data, but also to instructional applications, to provide a sufficient number of computers for students and teachers.

Should the district purchase hardware that is relatively new in the marketplace? The decision is an individual one, which is often guided by factors unique to the school district. When in doubt, however, it is best to choose hardware that has a history of successful existence.

Peripheral selection. Peripherals can be selected using the techniques previously described. It is important that peripherals be compatible with the software and hardware already chosen.

Vendor selection. After the planning committee decides upon the types of software, hardware, and peripherals that best meet the district's needs, vendors must be selected who can supply those products. For administrative computer systems, it may be helpful, but it is not essential, to purchase all equipment (hardware and peripherals) from the same vendor. This tactic can avoid problems in case of equipment malfunctions; one vendor cannot blame the other for failure of the equipment. For instructional computer systems however, it is

unnecessary to purchase all mechanical equipment from the same vendor. This is because there is often a variety of hardware brands in instructional computer systems for different courses and grade levels: therefore, it may be impossible to purchase all equipment from the same vendor.

Development of a Computer System Budget

After computer system components have been selected, the planning committee should prepare a budget, including proposed expenditures and anticipated revenues.

Proposed expenditures. Computer system expenditures are composed of investment costs and recurring costs. Investment costs consist of real capital costs, implementation costs, and human resource costs:

1. **Real capital costs** are for the initial implementation of the computer system. These expenses include the price of the materials for the computer system -- software, hardware, peripherals, computer furniture, and supplies -- and tax, freight, and installation charges;

2. **Implementation costs** are for physical site preparation and parallel runs;

3. **Human resource costs** include money spent on employees during the initial stages of computer system implementation. These are expenditures for training programs, conversion of data from manual to electronic forms, curriculum development, and perhaps development of additional custom-made software or consultant fees. There may be over-time pay, too. Employees must often work longer than the regular work day to operationalize a new computer system.

Investment costs are not easy to predict. Planners should allow for a contingency beyond projected expenditures, because there may be additional equipment to be purchased or

services to be contracted that were not anticipated during the early planning stages.

There are also recurring costs. These include on-going expenses for the computer system's daily operations, including employees' salaries, consumable supplies, utilities, insurance, on-going user training, provisions for data backup, depreciation of equipment, and equipment maintenance and repair. There can also be other miscellaneous expenses, such as subscriptions to computing magazines or information services and membership dues for professional computing organizations.

Anticipated revenues. Sources of funds for computer systems can come from four sources: local incentive (tax-payer dollars), federal or state government (state aid or federal grants), community action groups, or industry-education partnerships. The major source of funds for both administrative and instructional computer systems is taxpayer dollars in the general fund budget. For administrative computer systems, local incentive is usually the only source of funds. Federal or state monies for computer systems are usually ear-marked for instructional applications, and it is unlikely that community action groups would put forth effort to purchase a computer system for management applications. Private-sector firms are also more willing to donate computers for children. This makes good business sense in two ways. Parents of school-age children are potential customers and may purchase for home use the same brand of computer found in their children's schools.

Furthermore, it is good public relations to donate equipment for the use of children, rather than for adults.

Planners of instructional computer systems should initiate an aggressive search for funds. State and federal governments are recommended sources. Money is often available in the form of categorical aid or special grants for districts wishing to start an instructional computing program. Moreover, poorer districts are often eligible for more financial aid because of the government's desire to equalize computer access across a state or throughout the nation. These government monies can be distributed in a variety of ways. Some school districts use a mini-grant program to allocate federal monies. Teachers and principals are invited to submit proposals to the superintendent, which are then reviewed and evaluated at the central office level. The most innovative and promising as judged by proposal goals are awarded funds. This grass roots movement helps assure an equitable distribution of funds and also instills a feeling of pride in the users, which fosters acceptance of the new applications. Community action groups and private industry can be used to supplement computer funds received from taxpayers or government sources. The efforts of organized citizen groups can support computer purchases during lean budget years or when an austerity budget restricts expenditures.

Report of Findings

The last phase of the feasibility study is a written re-

port of the findings and recommendations of the planning committee. This report should be given to the chief school officer and may be accompanied by an oral report to both the administration and, upon invitation of the superintendent, to the board of education. The superintendent should have had opportunities for input to the feasibility study, either as a member of the committee or as a member of the various groups whose input was sought. However, an oral report during a meeting of the board of education is the first structured opportunity for board members to seek clarification and to give suggestions to the planning committee.

The written report should contain documents generated during the feasibility study that support the committee's recommendations. Typically, the written report contains one of three recommendations to the superintendent and the board of education:

1. **Termination of the project.** The committee recommends against acquisition and implementation of a computer system at this time. The report should contain in detail the reasons for the committee's decision. Supporting documents may include:

    a. Definition and description of the planning problem;

    b. Scope of the plan;

    c. Philosophies;

    d. Assumptions;

    e. Needs;

    f. Goals and objectives;

g. Intended outputs and/or applications;

h. Recommendations for material inputs to the computer system;

i. Proposed computer system budget;

j. Summary of the strategic plan.

Certain of the above documents may be more critical than others, depending on the committee's rationale for termination of the project. If a computer system cannot meet the needs of the district, it is important to include in the report a thorough delineation of the data processing or instructional needs of the district and reasons why a computer system cannot meet those needs. If finances are a problem, the committee should include their suggestions for potential material inputs and a detailed budget showing the anticipated expenditures for acquiring and implementing this computer system. Then, rationales should be included as to why these costs are prohibitive. Pending no further directives from the superintendent or the board of education, this recommendation dictates that all planning activities cease;

2. **Further investigation and study.** The committee requests more time and perhaps more resources to continue the feasibility study. All of the documents mentioned above are appropriate for inclusion in this report to show the board what progress has been made. Also, the committee should give reasons why a more definitive recommendation cannot be given at this time. Unless directed otherwise by the superintendent and the board of education, the planning committee will continue its strategic planning activities;

3. **Acquisition and implementation of a computer system.** The committee requests board approval of its recommendation to acquire and implement a computer system and authorization of the funds to do so. Supporting documents are the same as above. Of particular importance are the committee's recommendations for the selection of hardware, software, peripherals, and vendors, and a proposed budget. Also appropriate for inclusion are staffing requirements and a timeline scheduling implementation activities.

Among the rationales which can be used by the committee to convince the board of their position are the

ways in which a computer system can meet the needs of the district and the anticipated benefits of a computer system, including the improvement of present data processing or instructional operations.

If the superintendent and the board of education approve the recommendations, the planning committee can proceed by formulating tactical plans. The remaining chapters focus on the various concepts and practices that constitute a tactical plan for computer system implementation.

CHAPTER II

Designing A Logical Structure For The Computer System: Establishing Organization

CHAPTER II

DESIGNING A LOGICAL STRUCTURE FOR THE COMPUTER SYSTEM: ESTABLISHING ORGANIZATION

This chapter discusses the first of four areas of tactical planning for the proposed computer system. Designing a logical structure for the computer system involves identifying the various subsystems of the proposed computer system and determining how they should be structured to optimize computer system operations.

DESIGNING A COMPREHENSIVE COMPUTER SYSTEM

Having completed strategic planning activities, planners should realize that a computer system is composed of many different parts or subsystems. This macroscopic perspective is important to avoid a narrow planning focus. Each subsystem is important, and neglect in developing tactical plans involving all the subsystems can lead to computer system failure. Forgetting about a particular subsystem through oversight can lead to weak links in the computer system chain.

To design a comprehensive computer system, the planning committee should first identify the subsystems of the proposed computer system. One way to do this is to order computer system subsystems according to applications, such as computer assisted instruction, computer managed instruction, computer assisted administration, and computer assisted office work. Another way is to view various functions as subsystems, such

as purchasing, production, user support, management, maintenance, and change and growth. Still another way is to classify the subsystems as inputs and processes, such as people, machines, procedures, and data. Each subsystem can be further divided. For example, for an administrative computer system, a Procedures or Production Subsystem can be further divided by applications into a Payroll Subsystem, a Personnel Subsystem, an Accounting Subsystem, etc. For an instructional computer system, the People Subsystem can be divided into types of users -- teachers and students. Regardless of the type of classification used, it is important that each subsystem be discrete and contain little overlap with other subsystems. This is to help ensure that a change in one subsystem causes only minimal disruption to other subsystems and to the operations of the computer system in general.

DESIGNING AN INTEGRATED COMPUTER SYSTEM

Designing an integrated computer system involves the concepts of organization of subsystems and centralization of functions.

Integration of Computer System Subsystems

Comprehensiveness is only part of the process of designing a logical structure for the computer system. It is also important to organize the subsystems so they function as an integrated unit, working in harmony with each other. Internal integration of computer system subsystems is not enough, however. A computer system does not function in a vacuum, but

rather is a part of its larger environment -- the school district. Therefore, the entire computer system must be externally integrated with other school departments to maximize the benefits of the computer system to the district and to minimize disruptions of school district activities.

How can internal and external integration be accomplished? The first step should already have been accomplished by the planning committee: identification of the various computer system subsystems. The second step, which may have been accomplished in an informal manner during strategic planning, is identification of those larger school district subsystems which will interface with the computer system. For example, an administrative computer system handling payroll functions will affect various people subsystems, such as clerical users (those who input and process payroll data), administrators and board members (those who receive payroll reports), and all school district employees (those who provide payroll information and receive checks). The third step involves constant communication. There should be dialog among subsystems within the computer system. Every user should have basic knowledge about the other subsystems and should understand where he or she fits into the operations of the entire computer system. This results in better record-keeping and more meaningful data analysis for a district's administrative computer system. Furthermore, there should be communication between the computer system and those larger school district

departments which will be affected in some way by it. This can eliminate isolation of the computer system, reduce alienation between users and non-users, and make the computer system responsive to the needs of the entire district. An organization chart can be a useful tool for graphically representing the internal and external integration of the computer system.

Centralization of Computer System Functions

Over time, the computer system may expand and become more complex as more equipment, new applications, and a greater scope of users are added. When this happens, it is even more important that subsystems are integrated and operating in a coordinated fashion. Centralization of functions can help accomplish this. For both administrative and instructional systems, certain computer system functions should be coordinated by a central subsystem. These functions include: equipment maintenance and repair; purchasing, including software evaluation and purchase; user training and support; and management and supervision. For administrative computer systems, certain applications can also be centrally controlled and have uniform procedures: inventory management, energy monitoring, financial data processing, personnel records, and student data records. For instructional computer systems, it is advisable to have centralized curriculum development and software distribution.

The Computer System Coordinator

Subsystem coordination can be accomplished by a central

management subsystem. If functions are to be supervised by a central department, it is important that this department be headed by one person: a computer system coordinator. A job description for this position can include the following duties:

1. Coordinates and supervises (with other line administrators) the implementation of the computer system;
2. Facilitates and supervises (with other line administrators) the daily operations of the computer system;
3. Works to promote user acceptance of the computer system;
4. Organizes or directly provides user support, including in-service training, on-site trouble-shooting, and software demonstrations;
5. Coordinates selection, acquisition, and implementation of new software, hardware, peripherals, and supplies for the computer system;
6. Plans for and coordinates the orderly growth and expansion of the computer system;
7. For administrative computer systems, has ultimate responsibility for proper data input and maintenance.

The computer system coordinator should be an individual who is dedicated and responsible and who possesses a macroscopic perspective of the computer system. Ideally, the position should be full-time because of the scope of the responsibilities; however, administrative computer systems often have coordinators who assume these duties in addition to other tasks, such as an assistant superintendent for business who also oversees the computer system. The first computer system coordinator should be an in-house employee, because that per-

son can bring a knowledge of the district to the job. Also, that individual was most likely a member of the computer system planning committee and is therefore familiar with, and has had input to, the strategic and tactical plans for the computer system. Future coordinators can be either new hires or in-house promotions. The position should be an administrative one in which the individual is directly responsible to the superintendent. This helps guarantee the neutrality of the coordinator and deters any one department from claiming ownership over the computer system and unduly influencing its operations and future development. Furthermore, this organizational arrangement lends credibility to the position.

THE PEOPLE SUBSYSTEM

The People Subsystem is one of the most important parts of a computer system. A great deal of thought is usually given to the selection of software, hardware, and peripherals, yet planning for the needs of users is often overlooked. However, without the support and effort of the users, the computer system is doomed to failure.

This section will discuss two important design issues that concern the People Subsystem: facilities planning and user support.

Facilities Planning

Planning the facilities that will house the computer system is just as important as choosing components that are user-friendly. The planning committee, in consultation with build-

ing principals, should give serious consideration to the selection and preparation of computer rooms. For both kinds of computer systems, these rooms should have climate control, proper lighting to reduce monitor glare, adequate storage space, sufficient work surfaces, adequate electrical outlets -- preferably attached to separate, "clean" lines -- and aesthetic qualities to reduce eye strain. To minimize physical discomfort, computer furniture should comfortably position hardware and peripherals. For example, keyboards should be at elbow level; monitors should be 14" to 20" from the viewer and ten degrees lower than the line of sight. Also, work stations should provide adequate leg room and good back support. Sources of dust, such as chalk boards, should be eliminated. If writing surfaces are needed, dry-erase boards can be used. Special halon fire extinguishers should be installed; unlike conventional fire fighting equipment, halon extinguishers minimize damage to computer equipment. Room security is also important; computer rooms should be able to be locked when authorized users are not present, and the rooms should be equipped with both fire and smoke detectors and security systems.

Beyond these basic requirements, the design of computer facilities should be based on user needs and computer system applications. This is especially true for instructional computer systems, where computer programming classes are best placed in rooms which allow for collaboration and group effort, whereas CAI requires individualization and user privacy.

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The more common physical arrangements for instructional computer systems include:

1. A microcomputer lab;
2. Computers in the media center or library;
3. Computers permanently situated in a classroom;
4. A combination in a school building of labs, classroom computers, and portable computers;
5. Situational placement of computers, depending on function and/or user grade level.

User Support

Support is essential for new users of the computer system as well as for veteran users implementing new applications. It is extremely important for users to feel secure and well-supported, starting with the earliest stages of computer system implementation. User support can be a key factor in promoting acceptance and successful operation of a computer system. The purpose of a user support subsystem is to help users who are experiencing difficulties, to teach users new applications and techniques, and to disseminate to users information and helpful hints. The user support subsystem can also provide lines of communication between the central management subsystem -- and the computer system coordinator -- and on-site users.

A user support subsystem can be informally or formally organized and can rely on external experts or in-house talent. The following are examples of several different models for a user support subsystem.

The Formal, External User Support Subsystem

This is exemplified by a regional group of users of a specific software package. Representatives of the various computer systems can meet in a central location on a regular basis to discuss common problems, share solutions, and relate concerns to the commercial software developer. Membership in this users' group can include a hotline to the software developer for answering questions and a membership directory to enable users to call one another for advice and information. There can also be provisions to share software among computer systems.

User groups can also be based on type of hardware. These user groups are open to anyone in the public who either owns or is interested in that brand of hardware. Users of school district computer systems can also take advantage of this kind of group by attending meetings and calling other members for advice.

The Informal, External User Support Subsystem

One school district obtained the services of a part-time consultant to help users through the implementation phase. Users who had problems or concerns called a central number where the questions were recorded. From there, the calls were routed to the consultant who provided answers. The answers were then given to users as quickly as possible to give them a high level of support.

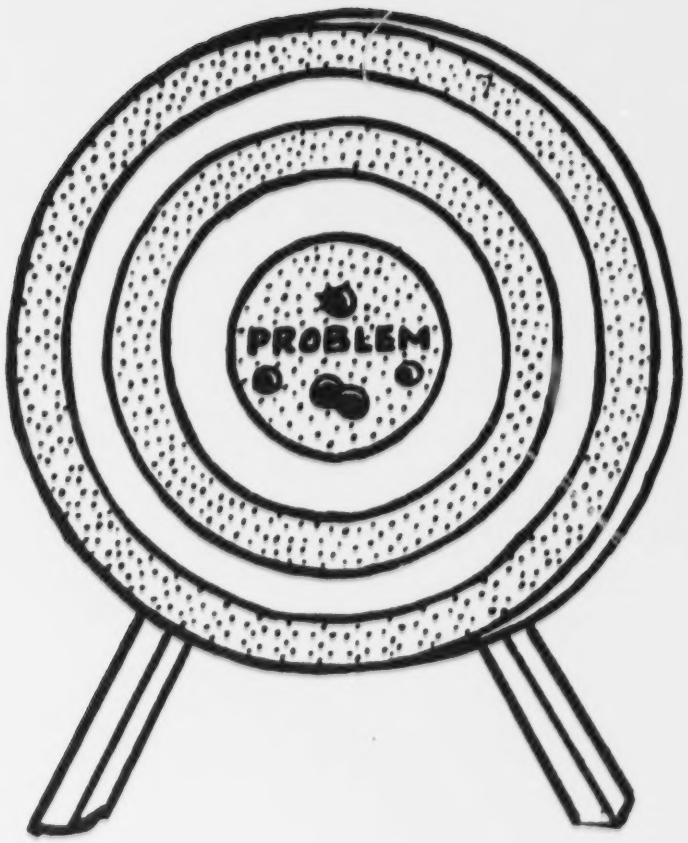
The Formal, Internal User Support Subsystem

In one school district, special facilitator teams offer support to users of the instructional computer system. Each elementary school has a facilitator team composed of a kindergarten teacher, a primary teacher (grades 1-3), an intermediate teacher (grades 4-6), the media specialist, and any other interested staff members. One person from the group becomes the lead facilitator for that team. The lead facilitator receives thorough training and is in constant communication with the computer system coordinator. The lead facilitator then passes on this knowledge to the members of his or her facilitator team, who in turn offer support to staff members in their respective grades. This method helps ensure continuity of operations at all sites, because training and support are identical among buildings. Because the facilitator team works closely with other staff members, the team is aware of their computing needs. This information can then be related to the computer system coordinator, via the lead facilitator. Other districts also use special teachers to assist users with new applications.

User support can also be provided through a staff newsletter. These publications can contain problem-solving techniques, new applications developed by users, software, hardware, and peripheral reviews, schedules for in-service training, and other helpful operating suggestions.

The Informal, Internal User Support System

This is typified by informal peer support groups whose members meet on a regular basis to discuss problems and share solutions. Users in different district locations can also call one another for advice and ideas.



CHAPTER III

Designing Effective Processes For The Computer System: Determining Outputs And Dealing With Constraints

CHAPTER III

DESIGNING EFFECTIVE PROCESSES FOR THE COMPUTER SYSTEM: DETERMINING OUTPUTS AND DEALING WITH CONSTRAINTS

This chapter deals with the tasks the planning committee must undertake to ensure effectiveness of computer system operations. The first step is to determine the nature and appearance of outcomes and to develop output formats for the computer system. The second task is to identify constraints that might reduce the effectiveness of the computer system and develop strategies to obviate them.

DETERMINING OUTPUTS FOR THE COMPUTER SYSTEM

During daily computer system operations, data input precedes data output; however, during the planning stages, the design of outputs and their requirements dictate the methods of data inputs. Planners should decide what they want the computer to produce; users will then know what kind of data must be fed into the computer.

Outputs for both administrative and instructional computer systems should meet the needs of the district and should reflect the goals and objectives formulated during the feasibility study. The design of these outputs can be guided by discussions with users of the proposed system and later refined by pilot tests of preliminary versions of planned outputs. Outputs can also be based upon current manual operations; however, using a computer system to simply translate manual ap-

plications into electronic ones is not taking advantage of the computer's power and capabilities. Planners can certainly use manual methods and reports as a basis for the design of computerized outputs, but they should also use their imaginations to determine how these outputs can be improved by computerization.

For administrative computer systems, the layout of output reports should be easy to understand, and users should know the deadlines for these reports and who should receive them. Once this has been established, report formats and distribution procedures should be changed only by authority of the management subsystem, i.e., the computer system coordinator. Both output and input forms should be designed to be user-friendly and self-explanatory to both those who input data and those who receive reports.

DEFINING CONSTRAINTS ON COMPUTER SYSTEM EFFECTIVENESS

There are many factors which can preclude maximal outputs for the computer system. One way to deal with these obstacles is to identify them and formulate ways to overcome them. The following sections discuss four common constraints that can affect computer systems effectiveness: system security, software piracy, equal access to computers for instructional computer systems, and good data for administrative computer systems.

Computer System Security

It is very important to provide for the physical sec-

urity of computer system components -- hardware, software, peripherals, data banks, and reports -- and also the security of electronically stored data.

Providing Physical Security for the Computer System

It is extremely important to limit unauthorized access to the computer system to prevent theft of or vandalism to equipment. The planning committee should recommend the installation of a commercial security device for this purpose. The committee should also write policies to ensure that users follow good security practices, such as:

1. Locking portable equipment and data files in a safe place at the end of the work day;
2. Making back-ups (in diskette and hard copy forms) of important data and storing them separately from the originals;
3. Using inventory control and anti-theft procedures similar to those used for audio-visual equipment;
4. Following established procedures for limiting access to computer rooms. For administrative computer systems, access to computer rooms should be limited to authorized users. For instructional computer systems, a designated staff member should always supervise student use of the computers;
5. Following established procedures for borrowing equipment;
6. Following operating procedures that help keep the equipment in good condition.

Providing Electronic Security for the Computer System

The planning committee should formulate ways to limit unauthorized electronic access to files stored on the computer system. Not only must the privacy and confidentiality of the

information be maintained, but it must also be protected from accidental or intentional alteration or destruction.

If the computer system is composed of stand-alone units, limiting physical access to the computer system will also provide electronic security. Networked configurations pose other problems, however, because electronic access can be gained through virtually any unit in the system. For these kinds of computer systems, it is necessary to devise methods to protect data. These methods can include:

1. A password system;
2. A division of labor so that no single user has access to the entire data file;
3. Use of audit trails and transaction logs;
4. Having administrative and instructional applications on different computer systems.

Software Piracy

Written policies to discourage illegal copying of software should be developed, conspicuously posted in the schools, and distributed to users. Copyrighted software should never be released for use in other districts; however, schools may wish to share software developed in-house with other districts.

Equal Access to Computers

The planning committee should establish provisions to ensure that the computer system is available for all appropriate users. This is less of a problem for administrative computer systems, whose users are generally fewer in number,

than for instructional systems, whose users can comprise the entire faculty and the general student body. Therefore, this section will address the problems of equal access to instructional computers.

In-House Solutions

It is important that all students -- including females and minorities -- be given the opportunity to use computers. Therefore, fair procedures must be developed for course selection and computer access time. As the computing program matures, it may be necessary to purchase more computers and to hire extra staff. Summer programs can be instituted for students who cannot fit computer courses into their schedules during the regular school year. It may also be necessary to extend the hours of the computer lab, having it open from 7:00 a.m. until 5:00 p.m. daily or even during designated evenings.

Provisions should be made for teachers to have adequate access to computers, with perhaps a microcomputer in every teachers' workroom for use during preparation periods.

Funding Problems

Many of the above solutions require additional staff and equipment, both of which are expensive. School districts should aggressively search for alternative ways to finance these expenditures. They should also work closely with state governments and departments of education to secure financial and political assistance for acquiring computers to ensure sufficient computer time for teachers and students.

Good Data for Administrative Computer Systems

Computer system outputs are only as good as their data. These inputs should be relevant, timely, accurate, and reliable. The single most important factor in insuring good data is the user. Users will accept this responsibility and soon can analyze and solve data problems without assistance.

Written procedures can help users input and process data in an effective and efficient manner. Not only do these procedures help users in daily operations, but they also provide uniformity of operations across the computer system.

Users should also have a macroscopic perspective of computer system operations: what kind of data are needed (inputs), how they will be used (processes), and what the finished reports will look like (outputs). Flow charts, which are often procedures in graphic form, can help users understand the integration of their work in the computer system.

CHAPTER IV

Designing Efficient Processes For The Computer System: Implementing The Computer System

CHAPTER IV

DESIGNING EFFICIENT PROCESSES FOR THE COMPUTER SYSTEM: IMPLEMENTING THE COMPUTER SYSTEM

It is now time to plan and carry out the actual implementation of the computer system. The planning committee has finished conducting a feasibility study, has made recommendations to the superintendent and the board of education, and has received their approval. A logical structure for the computer system has been devised, output formats have been developed, and constraints have been identified and provided for. At this point, the committee should develop a plan for change, provide for progressive mechanization to help ensure the efficiency of the computer system, and operationalize the system. This chapter deals with these three tasks.

DEVELOPING A CHANGE PLAN: FOSTERING USER ACCEPTANCE

The process used to disseminate an innovation throughout an organization is just as important as the innovation itself. Therefore, it is essential that the committee develop a plan to introduce the new computer system to users and to foster their acceptance of it. The composition of this change plan is dependent on many factors, such as the characteristics of the school district and the users, the personality of the change agents, and the relationship between the change agents and the users. However, there are some common practices that can be helpful in operationalizing the computer system.

Devising a Timetable for Implementation Activities

The first step in the change process is to develop a detailed calendar of implementation activities. This schedule will help ensure an orderly implementation process. This timetable can be part of the larger plan for the computer system developed earlier. Now, it may be necessary to revise and expand upon the implementation activities planned during the feasibility study. However, it is also possible for the planning committee to develop a separate implementation schedule at this time.

Conducting Initial Orientation Sessions

Open, two-way communication is the key to successful implementation of a new computer system. Therefore, the computer system should be introduced to all those who may be affected by it through the use of informal information sessions. These are not the more structured user training programs which take place just prior to operationalizing the system, but rather an opportunity for potential users to learn more about the new computer system and what computerization will mean to them. These orientation sessions should be macroscopic in nature: users should see the internal and external integration of the computer system and should understand their roles in it.

It is important to continue the flow of user input that has existed since the early planning stages. The presenter at the orientation sessions should be a patient listener. Ques-

tions should be welcomed, and answers should be provided as quickly as possible. New users should understand the reasons behind planning decisions. It may also be helpful to contact and work with the users' leaders, both the formal and informal ones.

Allaying Fears

A great deal of resistance to a new computer system is actually fear. Some people fear that the computer will displace them and leave them without jobs. Others are afraid that computer applications will be too difficult to learn. Then there are those that are uncomfortable with change in general. Orientation sessions must deal with these fears and work to eliminate them as potential causes of resistance to the new computer system. This can be accomplished by explaining the implementation plan and the uses and benefits of the system.

Explaining the implementation plan. It is important that users know when and how implementation will take place. They should be given a summary of the committee's progress to date, the anticipated goals and objectives for the computer system, and the proposed schedule of implementation activities. Expectations for the users should also be outlined. Users should know when and how training will be accomplished, and what inconveniences they may encounter during implementation.

Explaining the uses and benefits of the computer system. One of the easiest ways to promote acceptance of a new comput-

er system is to inform users of the capabilities of the computer and the benefits of computerizing current operations. Clerical users of administrative computer systems will appreciate the greater efficiency they can achieve using computers, resulting in a reduction of routine work, more accurate results, and information needs being better met. Teachers using a new instructional system can be shown the benefits of CAI and CMI; they can also be informed of personal, professional applications, such as word processing, spreadsheet applications, and data base management.

Promoting Support and Use of the Computer System

Open communication with new users can engender support of the computer system. For instructional computer systems, it may be helpful to have public presentations for community residents. Parent enthusiasm can transfer into the schools, making teachers more eager to use the new computers.

Acceptance and enthusiastic use of a computer system cannot be manufactured by a committee or mandated by the administration. It best starts as a grass-roots movement. The orientation sessions are for all potential users. However, more in-depth training sessions and initial use of the system should start with those most eager to participate. Their initial successes will encourage others to learn computerized applications and will accelerate acceptance of the computer system.

ESTABLISHING PROVISIONS FOR PROGRESSIVE MECHANIZATION

It is important to develop and emplace procedures which help maintain consistent and efficient computer system processes. This can be accomplished by establishing provisions for progressive mechanization of the computer system. Progressive mechanization guards against excessive informality of operations and helps ensure that daily tasks and procedures conform to formally stated goals and objectives.

Provisions for progressive mechanization should be established before the computer system is operationalized. Two recommended provisions are the development and use of written system documentation and planning and implementation of user training programs.

Written System Documentation

For both administrative and instructional computer systems, a set of written documents should exist to define operations and procedures and to guide and support users. System documentation, or user manuals as they are sometimes called, has other purposes as well:

1. It helps each user understand his or her role in the computer system;
2. It serves as a written record of changes made to the computer system;
3. It can be used as a training tool;
4. It helps preserve consistency of operations when there is a turn-over in personnel, because new staff members can use the documentation to help them perform tasks in the same way their predecessors did;

5. **It safeguards the investment of time and money used to develop the computer system,** because it is a written record of the system and each of its applications.

Some of the materials included in the user manuals will already have been developed by the planning committee, such as goals and objectives and organization charts. Additional documents may need to be written at this time. Materials should be developed for each application as soon as it is completed and everyone is satisfied with its processes and outputs. This way, the details of development are still in recent memory, and a complete and accurate set of documents can be written. The daily operations for the application can then be delegated to the users who, guided by the documentation, can function independently. This leaves computer system designers free to concentrate on developing new applications.

System documentation should be clearly written and arranged in a logical fashion. A loose-leaf notebook is recommended to allow users to update their manuals by adding or deleting pages. Users should also be encouraged to enhance their manuals with handwritten comments or additional documents. However, the computer system coordinator should periodically inspect all manuals to ensure a degree of uniformity among them.

It is recommended that user manuals consist of two types of documentation: technical documentation and procedural documentation.

Technical Documentation

This is the set of operating instructions for the software, hardware, and peripherals. Technical documentation is usually supplied by the vendor, except for software that is written in-house; in that case, school district programmers write the software manuals.

It may be necessary to re-write those sections of the technical documentation which are scanty or difficult to understand. It is also helpful to have a district-wide lending library of software manuals available for users. This can be especially helpful for users of instructional computer systems, where a variety of software is often used.

Procedural Documentation

This consists of written materials used on a regular basis to aid users in performing daily operations and computer system processes. Because this part of the documentation relates to aspects of the computer system that are unique to the school district, these materials should be developed in-house.

Documentation applicable to both administrative and instructional computer systems. The following is a list of items that are recommended for user manuals for both administrative and instructional computer systems:

1. **General description of the computer system.** This provides users with an overview of the computer system and should include information about the quantity, brand names, and configuration of the hardware, peripherals, and software in the computer system;

2. **Background information.** This can include planning

assumptions and the philosophy of the computer system;

3. **Statements of goals and objectives;**

4. **Statements of policies and administrative regulations.** These documents guide user behavior incritical areas;

5. **Organization charts;**

6. **Procedures and activites.** For administrative computer systems, these usually consist of directions for completing specific tasks and are designed for use by clerical personnel who input data and operate the computers. These directions can be in the form of a written outline or a graphic flow chart. For instructional computer systems, there are often general procedures for users or written activities for students and teachers. The procedures often cover topics like use of the computer lab, how to get equipment repaired, and how to borrow software. The activities are for classroom use by students and teachers;

7. **Job descriptions.** These specify the duties and responsibilities of key people in the computer system. Job descriptions are especially important for users of new computer systems because their jobs may now include different duties. Also, a job description is necessary when establishing the position of computer system coordinator;

8. **Training materials.** These are written documents that can be used during initial training sessions; they can act as reference materials when the formal training program has ended. Types of materials that can be included are a list of definitions of computer terms and actual training manuals. In-service course descriptions and staff newsletters can also be added on a regular basis;

9. **Input and output forms.** This informs users of the proper ways of inputting data and the output reports they can expect to receive. Although this type of documentation is more applicable to administrative computer systems, it is also useful for instructional systems whose applications include computer managed instruction.

Documentation applicable to administrative computer systems only. User manuals for administrative computer systems can also include procedure calendars. These calendars list deadlines for completion of tasks and due dates for output reports.

Documentation applicable to instructional computer systems only. The following documents pertaining to the teaching-learning function should be included in user manuals for instructional computer systems:

1. **Curriculum guides.** Teachers should know what is to be taught before they teach it; therefore, teachers of computer science/literacy courses should be provided with a curriculum to guide their lessons. Also, curricula should be available for teachers who wish to use computers as instructional tools. These curricula should be appropriate for the grade level of the students, the subject matter to be taught, and the computers to be used. A good curriculum which shows the teacher how the computer can be used in the classroom can also help foster acceptance of the computer system. Curriculum guides often contain goals and objectives for students, student and teacher activities, work sheets, and reference materials. The guide should also be comprehensive in nature to give teachers an overview of the course. Curricula for an instructional computer system should be developed before user training and system implementation. Curricular materials should be designed by those who will use them -- the teachers;

2. **List of software available in the district.** This informs teachers of the software in the district and helps them better plan their lessons. Appendix G contains a form which can be used to inventory software;

3. **Software evaluation reports.** This is an elaboration of the software lists. The results of reviews of various software packages completed during the feasibility study should be included in the user manual to help teachers choose the most appropriate program for a particular lesson. New reviews should be added

to this portion of the user manual as additional software is purchased;

4. **Reference materials.** A list of publications can help teachers better understand computers and incorporate them into their classroom. This list can provide information on the title and author of the reference, the publisher, its intended user, and the recommended grade level.

Planning and Implementing User Training Programs

It is essential for efficient computer system operations to provide structured user training programs. In addition to teaching users how to operate the system, training programs can also help foster acceptance of the new system by helping users overcome technophobia and by encouraging enthusiasm. Not only is training important for new users, it is also necessary for teaching veteran users new applications.

Just as it was important to develop plans for designing the computer system, it is important to develop plans for user training programs. These plans should address five areas:

1. **Who** will be trained?
2. **Why** will they be trained?
3. **What** will be taught?
4. **When and where** will training take place?
5. **How** will training be accomplished?

The following sections discuss these areas in greater detail.

Who Will Be Trained?

The first step in planning training programs is to determine the composition of the audience. If there is a choice of

who receives training first, it should start with those individuals most enthusiastic about the new computer system. When others see their peers experiencing success on the computer system, they will also want to get involved. Furthermore, early adopters of the computer system can form the beginning of a peer support network.

After the primary audience is selected, back-up people should be selected for each application. These individuals should also receive training so that they can substitute for others at a moment's notice. Also, it is important to include both routine users -- teachers or clerical staff -- and occasional users, the administrators. Inclusion of administrators in user training sessions is another way of demonstrating management support of the computer system; it can enable administrators to provide better and more informed supervision of computer system operations. If there is a large number of users to be trained, it is best to group them homogeneously according to their present level of computing skill.

For administrative computer systems, this is also the time to choose the data processing staff. Those selected should be competent and reliable; this is even more important than previous experience in electronic data processing. Successful computer system operations and outputs will depend on responsible data input by these individuals. It is also helpful if the staff has some background in education, because they will be better able to understand and meet the data pro-

cessing needs of the school district. Trainees for administrative computer systems should be only those individuals who will be receiving computers during the current academic year.

Why Will They Be Trained?

Goals and objectives should be developed for the training program. These goals and objectives can be used to provide structure to the lessons and to measure trainees' success.

What Will Be Taught?

Course content should be determined before training begins. Beginning training sessions should concentrate on demystifying the computer. There should be a general orientation to computing, with definitions of commonly-used terms and an explanation of how computers work. The next topic should be an application that users can use immediately. Training can then expand to include the entire set of applications users must know. The content of these lessons can be developed from an analysis of tasks each user will perform to operate the computer system.

Training programs also provide opportunities to elaborate upon users' future duties and responsibilities. Concurrent with this, training sessions can include explanations of each user's role in the system and the flow of information and procedures.

It is helpful to provide teacher training for both classroom applications and personal, professional needs, including word processing, data base management, electronic spread-

sheets, grade book programs, and graphics. Teachers are then able to use computers to perform routine, clerical tasks more efficiently and effectively.

When and Where Will Training Take Place?

The logistics of training should be determined next. It is important that training take place before actual implementation to help ensure efficient and effective use of the computer system. Furthermore, user education should not be a one-time event, but rather a continuous program with follow-up sessions scheduled at regular intervals to update users' skills and enhance their knowledge of computer applications.

There should be ample time for participants to learn and absorb all the information necessary for computer use. A small amount of training, presented in a rushed and hurried manner, can leave users confused and discouraged and may lead to misuse or under-use of the computer system. It is recommended that training be conducted during a period of release time during the regular work day; people may be somewhat reluctant to attend classes during their free time. For a release time arrangement to be successful, administrators need to be flexible and supportive of the goals of training, because release time can at best be inconvenient and at worst be disruptive to daily operations. It is a small price to pay, however, to ensure that those who need training will attend the sessions. Some districts have been successful in providing training outside the work day; however, they usually pro-

vide an incentive for attendance, such as in-service credit, credit toward re-certification, or free tuition for the courses. In conclusion, training should not be an additional duty for people to accomplish on their own time and at their own expense; there should be time set aside specifically for user education.

There are several ways that training can be offered. The following is a partial list of delivery systems that other school districts have found successful:

1. **Conferences and conventions;**
2. **Summer training sessions;**
3. **Vendor-sponsored training sessions;**
4. **Classes at a local university.** Often, the school district offers credit toward re-certification or pays the tuition;
5. **Half-day in-service sessions** during the school day;
6. **Classes sponsored by the district's adult education program.** Monetary or certification incentives are often offered for attendance;
7. **Periodic workshops or in-service days** throughout the year to discuss problems and conduct additional training;
8. **After-school instruction.**

Two other concepts worth noting are the laboratory and the take-home approaches. One school district used a combination of classroom and laboratory activities to train the clerical staff to use the administrative computer system. Each participant had his or her own computer and printer. Formal classroom instruction alternated with practice sessions in the

lab. The lab should be occasionally supervised by an instructor. This allows participants to function independently and also build a network of peer support, yet provides expert assistance when necessary. Another district used a laboratory to train teachers to use computers. Students and teachers worked together in the same lab, and a paid consultant provided instruction to the students at the same time that teachers received in-service.

Several school districts participating in the study reported that they allowed teachers to take computers home overnight or during weekends or vacations. This way, they could continue the learning process at home and also have more time to experiment with new techniques or applications at their leisure.

How Will Training Be Accomplished?

Training plans should include who will teach, how the information will be presented, and what kinds of instructional aids will be used.

Many school districts use a network approach to training. Representatives from each building or user site receive intensive, in-depth training. These individuals then return to their buildings and train the remaining users. These peer instructors also form the basis of a user support group; they act as consultants and provide on-site assistance to their colleagues. School districts found that this instructional network approach, coupled with peer support, encourages user

acceptance of the new computer system.

Hired consultants, university professors, and staff from local computing consortia can also act as trainers. These consultants, if retained by the school district for a period of time after formal training sessions have ended, can give further assistance to users during the initial stages of computer system implementation.

Written materials should be distributed prior to the training sessions. User manuals consisting of system documentation should be included in the packet of training materials, along with any other information participants may need. A schedule of times and locations of training sessions should be distributed to all potential participants well in advance, so they may pre-register. Furthermore, prior notice of the sessions may engender interest in the computer system and the training program.

Training should be conducted in a non-threatening and supportive atmosphere, with participants experiencing initial success. Good instructional techniques should be used, and there should always be ample time for questions and answers.

OPERATIONALIZING THE COMPUTER SYSTEM

Computers should be put into offices or classrooms as soon as possible after user training ends. The process of operationalizing the computer system should be accomplished in a systematic manner and should follow the implementation plans previously made by the planning committee.

The computer system should be phased in gradually, with one application computerized at a time. One of the biggest mistakes computer system designers can make is emplacing too many applications too quickly. For administrative computer systems, the initial conversion of data from manual to electronic forms requires careful attention to detail to ensure data accuracy. This requires a great deal of time and user patience, which would be lacking in a hasty implementation process. With both administrative and instructional systems, users will be awkward and slow when first using computers; there is usually a decline in productivity during the implementation period. Therefore, users should not be encumbered by over-ambitious design efforts. This can only lead to frustration with and alienation from the computer system. The first application to be computerized should be an easy one. Users will accept the computer system more readily if their first experiences are satisfying and productive.

For each application that is computerized, parallel runs, also known as pilot tests, should be used. Manual procedures should not be abandoned until computerized applications are working satisfactorily. It is important during this trial period to solicit user feedback to eliminate the "bugs" from the computer system and to fine-tune its processes. This practice will also help promote user acceptance of the computer system.

During the implementation stage, there are several spec-

ific tasks which must be accomplished. It may be necessary to devise user schedules for administrative computer systems. For instructional computer systems, student and/or teacher schedules should be established to help ensure equal access to computers.

Users may be aided during this period by daily, weekly, and monthly objectives -- "to do" lists -- determined by the computer system coordinator. These lists should also be related to the computer system's annual goals. This technique can then continue and become a standard operating practice.

CHAPTER V

Evaluating The Computer System: Providing For Feedback And Adaptation

CHAPTER V

EVALUATING THE COMPUTER SYSTEM: PROVIDING FOR FEEDBACK AND ADAPTATION

It is important that computer system planners acknowledge and plan for the inevitability of change. For the computer system to continue to meet the needs of the school district, it must be adaptable. Adaptation can take two forms. Regulation and maintenance is the process of making small adjustments to computer system inputs, processes, or outputs. Growth and change take place when major modifications are made to the computer system.

CATALYSTS OF ADAPTATION

Both kinds of computer system adaptation can be precipitated by environmental change and system stress. The amount of environmental change and the degree of system stress are important factors in determining the degree of corrective actions, i.e., minor regulations and maintenance or major changes and growth.

Environmental Change

The computer system's immediate environment -- the school district -- can undergo a transformation. There can be a new superintendent or board of education with different ideas concerning computing than their predecessors. A change can occur in the fiscal climate of the district, resulting in a variation in the amount or source of funds that support the

computer system. There can also be changes in the external environment of the computer system. The computer industry is very dynamic. New products continually appear, and occasionally even disappear when vendors or manufacturers go out of business. New government regulations concerning the purchase of new equipment, report formats and procedures, or fiscal support can affect the computer system.

Computer System Stress

Computer system stress can cause adaptation to take place. Any factor that threatens or actually disrupts the status quo within the computer system contributes to system disorder. These factors can consist of changes in the environment or can result from internal computer system problems, such as a change in computer system users or equipment malfunctions. The indicators of a state of entropy in the computer system are inefficient processes and ineffective outputs.

CONTROLS

Controls are ways of detecting environmental changes and system stress. Controls consist of two parts: (1) evaluation of the computer system and (2) feedback of evaluative information to computer system planners and managers.

Evaluation

The computer system should be formally evaluated on a regular basis to determine what improvements can be made in its design and performance. There are two types of evaluation

that should be performed: process and product.

Process Evaluation

Process evaluation examines computer system efficiency to determine if any improvements should be made to its daily operations. Monitoring computer system processes is especially important during the early phases of implementation so that refinements can be made before small problems become major ones.

Process evaluation can take many forms:

1. **An on-going log of problems** kept by users. This can include comments concerning the versatility, utility, and ease of operation of the computer system. It can also be used to record problems with data access, accuracy, or security;

2. **On-site observations.** The planning committee, the computer system coordinator, or appropriate line administrators can observe users in action to determine if there are any problems with the computer system. Some school districts use these observations as part of their annual evaluations of teachers. In these cases, administrators observe a classroom to determine how efficiently teachers use computers for instruction;

3. **Comparison of the computer system against other school districts' computer systems.** The computer system planning committee or the computer system coordinator can visit other school districts and talk with their computer users to ascertain how operations are performed at those sites;

4. **Questionnaires.** Questionnaires can be sent to users, who can evaluate the computer system.

Product Evaluation

Product evaluation measures the effectiveness of the computer system to determine if its planned goals and objectives are being accomplished. Product evaluation can take several

forms:

1. **Examination of computer system outputs** by the computer system planning committee or the computer system coordinator;

2. **Measurement of student achievement** using standardized test scores to determine the cognitive and affective gains made by learners;

3. **Measurement of growth in student enrollment in computer classes.** This type of evaluation is based on the assumption that the consumers of instructional computing -- the students -- would not enroll in increasing numbers for classes that were mediocre or poor;

4. **On-site visits to other school districts** to compare computer system outputs;

5. **Questionnaires.** Survey forms can be used to evaluate the effectiveness of computer use.

Feedback

Evaluation is useless unless the information is received by those who can correct computer system deficiencies. Feedback transmits the results of evaluations to relevant persons.

A continuing computer system planning committee should be established to assess feedback about the computer system and plan for its adaptation. The committee should consist of some, if not all, of the members of the original planning committee. The computer system coordinator should also be included.

The role of the coordinator in computer system adaptation is two-fold. As a member of the on-going planning committee, he or she will be involved in making major changes to the computer system. However, as facilitator of daily operations,

this person is responsible for computer system regulation and maintenance. The committee's involvement in these minor adjustments is unlikely and unnecessary. This is because regulation and maintenance involves smaller changes which remedy immediate needs. However, the committee should always be kept informed of actions taken to correct minor deficiencies in the computer system.

REGULATION AND MAINTENANCE

The process of regulation and maintenance remedies minor dysfunctions in the computer system and prevents the more serious conditions of system degeneration and failure.

The most common regulating procedure is that of equipment maintenance and repair. For administrative computer systems, equipment repair should be provided by a hired technician, such as one from a local computing consortium, equipment manufacturer or vendor, or computer repair shop. A combination of a hired technician and a trained, school district technician can also be used. The reliance upon outside repair expertise is necessary because of the often complex nature of the equipment. Administrative computer systems often contain hardware with more complex capabilities and a greater number of sophisticated peripherals than do instructional computer systems. It is also recommended that these hired technicians be retained through a service contract.

For instructional computer systems, an in-house technician, a hired technician, or a combination of the two can be

used. However, the combination approach is recommended because of its flexibility and cost-effectiveness. The majority of maintenance work can be performed by a school district technician; occasional repairs that are of a major or difficult nature can be done by a hired technician. Services of a hired technician should be retained on an "as needed" basis because of the infrequent need for these kinds of services, as opposed to administrative computer systems, where all or most of the repair work is performed by outside experts.

One school district provides for equipment maintenance through a computer repair course. The course focuses on computer technology and electronics and is offered to both college-bound and vocational education students. The students, under the guidance of their teachers, repair the district's hardware; the school has even become an authorized service center for their brand of computers.

Other examples of computer system regulation and maintenance include:

1. **Expanded use of an application;**
2. **Modification of documents** in the users' manual;
3. **Curriculum updates.** Some school districts find it useful to modify their computing curricula in response to feedback received the previous year.

CHANGE AND GROWTH

Changes in and growth of a computer system remedy problems of a more serious nature -- ones that cannot be solved through regulation and maintenance. In addition to environ-

mental changes and system stress, two other conditions are needed for change and growth: the computer system's ability to change and deliberate, rational action.

The Computer System's Ability to Change

Good computer systems possess the ability to change and grow. The planning committee, both in its early stages and in its on-going form, should accept the inevitability of change for the computer system: The planning process will never end. To reflect this awareness, a multi-year plan should exist, and it should be reviewed and updated annually, with a future year added as the current year expires. This plan serves as a road map of committee recommendations for system enhancements.

Deliberate, Rational Action

The ability of the computer system to change will not produce change; purposeful action must take place. By following the multi-year plan mentioned above, changes to the computer system can be systematically made. Although rational action is important for the process of system regulation and maintenance, it is crucial for the success of computer system changes. This is because major changes are more unsettling than minor modifications. Also, computer system changes usually require a larger outlay of funds than do more minor alterations.

When making major changes to the computer system, it is important to minimize disruptions to the users. Use of restraint can help accomplish this. The computer system should

be enhanced only after original applications are performing to everyone's satisfaction. It is also necessary to have good controls and reasonable timetables to guide computer system growth. There should be extensive communication with users during the entire change process; in-service programs may even be necessary, especially if new equipment or additional applications are added. User involvement helps promote acceptance of the changes.

The following are examples of changes commonly made to administrative and instructional computer systems. These changes contribute to the system's development and enhance its ability to perform in a more efficient and effective manner:

1. **Changes in hardware.** As computer technology improves, many school districts update their hardware by purchasing new machines or modifying existing ones to increase their speed, memory, and power;

2. **Additions to hardware.** Often, school districts find it necessary to add more computers to accommodate more users. Some unique examples for instructional computer systems include:

    a. Adding low-cost micros. Even in schools that standardized on brand of hardware, non-standard hardware can be added, if it meets the needs of the districts;

    b. Adding hardware built from kits by the district's industrial technology students;

    c. Creating a portable microcomputer lab using lap computers;

3. **Increased networking capabilities.** Many districts start with stand-alone units and then expand to local area networks or distributed data processing. Administrative computer systems often use this new networking capability to transfer data between users' micros and a larger computer located on campus or

off-site. This allows for decentralization of processing, yet centralization of storage. Planners of instructional computer systems often expand existing networks by adding more units;

4. **Expanded applications.** After users discover the power and versatility of computers, they often wish to computerize even more tasks. Thus, as the system ages, there may be a need for more applications.

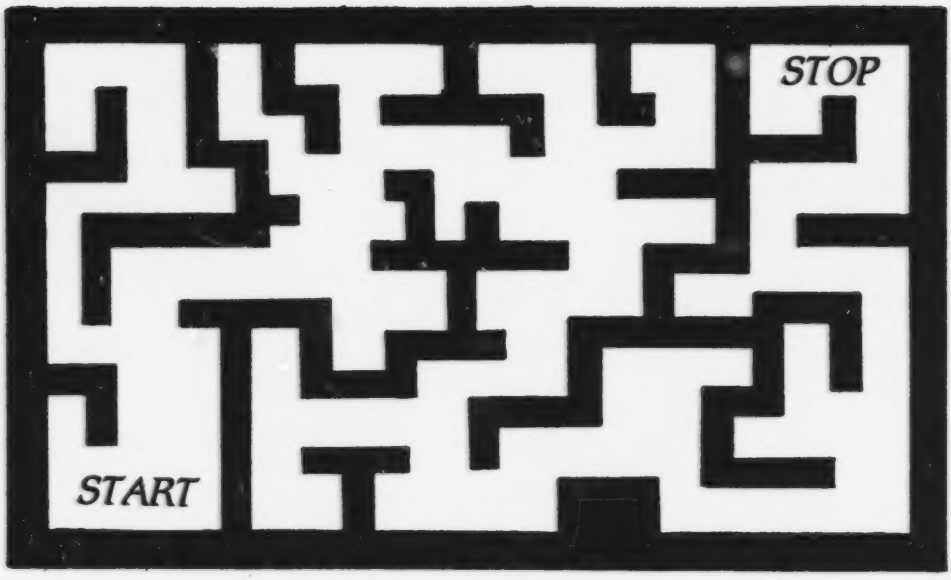
In addition to the above changes, software for administrative computer systems is often upgraded or new programs added, especially when there is a need to expand the number of applications. Also, after a period of time, the present peripherals may become inadequate. For example, the district may progress from dot matrix printers to daisy wheel printers to laser ink printers. Data storage on floppy disks may become too cumbersome, so a hard disk may be purchased.

For instructional computer systems, curricula may undergo changes as the system evolves. New curricula may be added or large portions of the existing curricula may be rewritten to accommodate other changes in the computer system or additional user needs.

ON-GOING PLANNING

Planning for the computer system is never-ending. The entire planning cycle discussed in this model -- from choosing purposes and parts to evaluation and adaptation -- may need to be repeated at regular intervals to keep the computer system efficient and effective. Over the years, membership on the planning committee may change, equipment purchases may vary, and outputs may look different, but there should be one

constant throughout time -- the goal of designing a computer system that can meet the needs of the school district, facilitate the work of staff, and improve the education of students.



CHAPTER VI
Synthesis Of The Model

CHAPTER VI

SYNTHESIS OF THE MODEL

The Comprehensive Model for the Design of Micro and Mini Computer Systems in School Districts was based on a set of design criteria first extracted from the relevant literature and then refined by the results of a nation-wide survey of school districts nominated for their outstanding design or use of micro or mini computer systems. Staff members in selected school districts from the survey populations were also interviewed to gain additional insights into the process of designing school district computer systems.

Educational administrators can use the study's model as a practical guide for planning and implementing computer systems in their districts. The model contains essential design concepts, concretized with corresponding practices. Many of these practices are illustrated with examples submitted by survey respondents.

A synthesis of the model follows. The action statements in this summary are presented in a preferred sequence: Designers should follow the procedures in the order presented below to achieve optimal results.

PART I: STRATEGIC PLANNING ACTIVITIES

A. Plan for the computer system: Choose purposes and parts.

1. Write strategic plans to guide the process of computer system design.

a. Use a systems approach and have plans that are macroscopic in nature.

b. Follow these plans in their original form, making only minor, necessary modifications.

c. Perform these two strategic planning activities first:

1. Define and describe the computer system planning problem. This can set forth in general terms:

a. The reasons for undertaking a computer system planning project at this time, such as, for an administrative computer system, the pervasiveness of computers in society or the ready availability of new, efficient management tools;

b. The expected outcomes of this planning project, such as, for an instructional computer system, graduates better prepared for the world of work;

2. Determine the scope of the plan, e.g., all schools in the district or just the elementary buildings; all management applications or just financial data processing.

2. Conduct a feasibility study to identify needs of the school district and to propose ways to meet those needs.

a. Establish a computer system planning committee.

1. Choose committee members by a "selected nomination" process.

a. Obtain nominations of potential committee members from the staff.

b. Select those individuals for committee participation who:

1. Represent a group of potential users;

2. Are knowledgeable about the school district and its computing needs.

c. Send a written invitation-to-participate

to those selected, outlining the functions of the committee and their duties as committee members.

2. Include as members on a committee for designing an administrative computer system:

   a. Central office administrators other than the superintendent. (Have the superintendent sit on the committee on an "as needed" basis);

   b. Building principals;

   c. Secretaries and clerks;

   d. Data processing professionals;

   e. Consultants or outside experts (optional).

3. Include as members on a committee for designing an instructional computer system:

   a. Central office administrators other than the superintendent. (Have the superintendent sit on the committee on an "as needed" basis);

   b. Building principals;

   c. Teachers;

   d. Community representatives and parents (optional);

   e. Consultants or outside experts (optional).

4. Charge the committee to undertake the feasibility study, and if deemed appropriate, to plan for the implementation of a computer system.

b. Undertake the following preliminary planning activities:

   1. Appoint a chair for the committee.

   2. Follow accepted meeting practices.

   3. Use division of labor within the committee to

perform planning tasks in an efficient manner. Have subcommittees report their findings to the entire committee.

4. Obtain the support of top management and the board of education.

   a. Obtain a written statement of the superintendent's commitment to the computer system design project.

   b. Encourage manifest management support in other ways, such as:

      1. Adequate allocation of funds for a computer system;

      2. Cooperation with the planning and implementation process;

      3. Provision for user training sessions;

      4. Use of the computer system.

   c. Report the committee's findings directly to the superintendent.

5. Schedule planning activities, such as: committee member training; computing needs assessment; investigation and selection of material inputs; presentation of recommendations; tentative implementation target dates.

6. Provide training for committee members. Include basics of electronic technology in general and educational computing in particular. Use as methods of training: written materials; courses; conventions; visits to other school districts; hands-on experience.

7. Write assumptions underlying the design process, such as:

   a. Computers are relatively easy to use;

   b. The influence of computers on daily life is increasing;

   c. Some degree of computer literacy is necessary for productive employment and participation in society.

8. Write philosophies for the computer system, such as:

    a. Educators must meet the needs of a new generation of computer users;

    b. Students should be made aware of computers and their impact upon society;

    c. All students should have the opportunity to learn computing skills appropriate to their abilities and their career goals.

c. Gather information about data the proposed computer system will process.

    1. Perform a comprehensive computing needs assessment for both instruction and management. Sources of information about data needs include: written surveys of and interviews with potential users; discussions with planning committee members; existing written procedures, documents, and records; current operations; outside resources, such as conferences, computing publications, and other school districts.

    2. Write computer system goals, based on assumptions, philosophies, and needs, as multi-year purposes.

    3. Write computer system objectives, based on goals, as shorter-term purposes.

d. Gather information about the material inputs that can comprise a computer system.

    1. Write specifications of required attributes for the selection of material inputs.

        a. Base these selection criteria upon the needs, goals, and objectives determined earlier.

        b. Base specifications on functions and performance standards designed to meet goals and objectives, rather than product characteristics.

        c. Develop specifications that are future-oriented and allow for the growth of the

system.

d. Decide tentatively on the desired electronic configuration(s) for the proposed computer system. Choose among:

   1. Stand-alone units (recommended for instructional computer systems);

   2. Local area networks;

   3. Distributed data processing (recommended for administrative computer systems);

   4. Remote area data processing.

e. Decide tentatively on the desired degree of standardization for software, hardware, peripherals, and supplies. Consider standardizing on brand for hardware, especially for administrative computer systems.

f. Determine the importance of price in selecting material inputs.

g. Develop specifications for material inputs in this order:

   1. Software, e.g., meets the needs of the users; is user-friendly; is versatile and flexible; is currently available in the marketplace;

   2. Hardware, e.g., has the ability to run the selected software; has the capacity for system expansion and upgrading; is flexible and capable of performing multiple functions; has networking capabilities; has features to meet users' needs;

   3. Peripherals, e.g., can meet requirements for data processing and user comfort; are compatible with the selected software and hardware; are available in the marketplace;

   4. Vendors, e.g., a good reputation for product support and service; financial stability and a history of existence;

provisions for on-site product repair; convenient location.

2. Seek information about alternative software, hardware, peripherals, and vendors available in the marketplace from: references; product observation and trial use; requests for proposals; product reviews in computing publications; consultants.

3. Make decisions about material inputs to a computer system.

   a. Analyze the alternatives.

   b. Make selections. Choose software first, followed by hardware, peripherals, and vendors.

4. Develop a written computer system budget.

   a. Include in the budget:

      1. Investment costs:

         a. Real capital costs, i.e., the price of software, hardware, peripherals, furniture, and tax, freight, and installation charges;

         b. Implementation costs for preparing computer rooms and parallel runs;

         c. Human resource costs for user training, curriculum development, and conversion of data from manual to electronic forms;

      2. Recurring costs, e.g., employees' salaries; consumable supplies; utilities; insurance; equipment maintenance and repair; computing magazine subscriptions; membership in professional computing organizations.

   b. Investigate sources of funds to support the computer system.

      1. Use taxpayer dollars as the major source of funds;

2. For instructional computer systems, also investigate the possibility of government funds and to a lesser extent, support from community action groups and private industry.

e. Report findings.

1. Present to the superintendent an oral and written committee report on the feasibility of establishing a computer system. Upon invitation of the superintendent, present the report to the board of education.

2. Include in the written part of the report, all documents generated during the feasibility study which support the committee's recommendation.

3. Make one of three recommendations at this time:

a. Terminate the project;

b. Continue further investigation and study;

c. Acquire and implement a computer system. Proceed on the basis of an approved feasibility report to the tactical planning activities below.

PART II: TACTICAL PLANNING ACTIVITIES

A. Design a logical structure for the computer system.

1. Design a comprehensive computer system by identifying and then ordering into subsystems all possible components or functions of the computer system, for example:

a. Computer assisted instruction (CAI), computer managed instruction (CMI), computer assisted administration (CAA), and computer assisted office work (CAO);

b. People, machines, procedures, and data;

c. Purchasing, production, user support, management, maintenance, and change and growth.

2. Design an integrated computer system.

a. Internally integrate the subsystems within the computer system so that they work in harmony with each other.

b. Externally integrate the computer system with other departments in the school district to maximize the benefits of the computer system to the district and to minimize disruptions to daily activities.

c. To accomplish internal and external integration:

1. Identify computer system subsystems;

2. Identify the larger school district subsystems which will interface with the computer system. For example, an administrative computer system handling student information will affect the people subsystems of principals, teachers, and pupil personnel staff (nurses, guidance counselors, attendance officers, etc.);

3. Communicate with all subsystems that will be using or will be affected by the computer system;

4. Develop an organization chart to graphically display internal and external computer system integration.

3. **Centralize support and management functions for the computer system, e.g., equipment maintenance and repair; purchasing; user training and support; management and overall system coordination. Designate a computer system coordinator to facilitate computer system organization, implementation, and operation.**

4. **Give extra attention to the People Subsystem.**

a. Select physical arrangements for the computer system which best meet users' needs. Examples of physical arrangements for instructional computers include:

1. A microcomputer lab;

2. Computers in the library or media center;

3. Computers permanently situated in a classroom;

4. A combination of the above;

5. Situational placement of computers, depending on function and/or user grade level.

b. In consultation with building principals, select and ergonomically prepare rooms to receive the computer equipment.

1. Prepare these facilities to meet the operating requirements of the equipment, such as:

a. Climate control;

b. Adequate electrical outlets, including separate, "clean" lines;

c. Dust-reduced environment;

d. Physical security devices.

2. Prepare these facilities to meet the comfort requirements of the users, such as:

a. Adequate storage space;

b. Adequate space for displaying working documents;

c. Reduced eye strain, obtained by minimizing glare from light sources, properly positioning monitors, and providing aesthetically pleasing decor;

d. Physical comfort during use, provided by proper keyboard height, good chairs for back support, and adequate leg room.

c. Provide for a system of user support to aid users and to help solve their computing problems, including:

1. In-house peer support groups;

2. Regional user groups;

3. Regular school district computing newsletters;

4. Vendor support.

B. Design effective processes for the computer system: Determine outputs and deal with constraints.

1. **Determine first the nature and appearance of outputs, e.g., reports, lists, screen displays, computer literacy skills, and intangible student benefits.**

   a. Design outputs to meet the computing needs of the district and to reflect the goals and objectives established earlier.

   b. Guide output design by:

      1. Discussions with potential users;

      2. Examination of current manual operations.

2. **Then design the nature and appearance of data inputs that will produce desired outputs.**

3. **Determine possible constraints to computer system effectiveness and move to obviate them.**

   a. Provide for the physical security of the computer system, e.g., locking portable equipment and data files in a safe place at the end of the day; making back-ups of data and securely storing them; using inventory control; establishing and enforcing procedures for limiting access to computer rooms and borrowing equipment; following operating procedures that help keep equipment in good condition.

   b. Provide for the electronic security of the computer system and its data, e.g., a password system; a division of labor so no single user has access to the entire data file; audit trails and transaction logs; having administrative and instructional applications on separate computer systems.

   c. Discourage software piracy by promulgating and distributing policies and enforcing them;

   d. Provide equal access to computers, especially for students using instructional systems, e.g., provisions for equity in course selection and access time; use of alternative sources of support (community action groups, private industry, local universities) to provide more computer access time for students.

   e. Develop procedures to ensure that data inputs are relevant, timely, accurate, and reliable; this is especially important for an administrative compu-

ter system. Do this by: encouraging user responsibility for good data input; developing written procedures for data input; developing flow charts to help users see "the big picture" and the importance of their roles in computer system operations.

C. Design efficient processes for the computer system: Implement the computer system.

1. **Develop an implementation plan for the computer system.**

   a. Develop a timetable for implementation activities, such as: user orientation; preparation of written documentation; user training; computer system phase-in.

   b. Conduct initial orientation sessions to introduce the new computer system to users and to the school district community.

      1. Allay users' fears of the new computer system.

         a. Explain the implementation plan, including goals and objectives for the computer system and expectations for users.

         b. Explain the uses and benefits of the computer system.

      2. Promote support and use of the computer system through open communication. Recognize that enthusiastic use of the new computer system will best start as a grass-roots movement, rather than as a top-down mandate.

2. **Establish procedures to help ensure consistent and efficient computer system operations.**

   a. Develop written system documentation for users (user manual).

      1. Include in the user manual technical documentation for operating hardware, software, and peripherals.

      2. Include in the user manual procedural documentation to aid users in performing daily operations.

a. Provide for both administrative and instructional computer systems: a general description of the computer system; background information, including planning assumptions and the philosophy for the computer system; statements of goals and objectives; organization charts; procedures; job descriptions; training materials; input and output forms.

b. Provide for administrative computer systems: procedure calendars listing deadlines for completion of tasks and due dates for output reports.

c. Provide for instructional computer systems: curriculum guides; lists of software available in the district; software evaluation results; reference materials.

b. Plan and implement user training programs. Write plans outlining the intended audience, the purposes of training, the information to be taught, the times and locations of training, and the methods of instruction.

3. **Operationalize the computer system.**

a. Phase-in the computer system gradually, computerizing one application at a time.

b. Conduct parallel runs of computerized applications simultaneously with manual operations. Abandon manual operations only after computerized applications are working satisfactorily.

D. Evaluate the computer system: Provide for feedback and adaptation.

1. **Evaluate the computer system on a regular basis to determine changes in its environment (the school district or the larger technical, political, or social environments) and to discover the presence of system stress or disorder.**

a. Examine the efficiency of computer system operations through process evaluations, e.g., on-going logs of user problems; on-site observations; comparisons of the computer system against other school districts' computer systems; questionnaires.

b. Examine the effectiveness of computer system outputs through product evaluations, e.g., examination of computer system outputs; measurement of student achievement; measurement of growth in student enrollment in computer classes; on-site visits to other school districts to compare computer system outputs; questionnaires.

2. Ensure that the results of the evaluations are received by the computer system coordinator, the planning committee, and appropriate line administrators.

3. Make minor adjustments to the computer system to prevent serious problems, such as:

   a. Repair and maintain equipment:

      1. For administrative computer systems, use the services of a hired repair technician retained through a service contract;

      2. For instructional computer systems, use a trained school district technician for maintenance and minor repairs and a hired technician for major repairs. Retain the services of the hired technician on an "as needed," rather than a service contract, basis;

   b. Expand use of an application;

   c. Modify documents in the users' manual;

   d. Update curricula.

4. Make major changes to the computer system to combat conditions of system stress and disorder, e.g.:

   a. Upgrade hardware, by purchasing new machines or modifying existing ones to increase speed, memory, power;

   b. Supplement existing hardware by adding: low-cost micros for certain instructional tasks; hardware built from kits by the district's industrial technology students; a portable microcomputer lab using lap computers;

   c. Increase network capabilities;

   d. Expand applications and upgrade or add software;

CHAPTER VII
Concluding Remarks

CHAPTER VII

CONCLUDING REMARKS

This chapter offers some final thoughts on the model from past, present, and future perspectives and makes some assumptions about the next generation of computers and their possible effects on the design process.

GENERAL OBSERVATIONS

This section discusses some general observations regarding the concepts of planning and user involvement as they apply to computer system design in particular and school administration in general, the excitement level in educational computing, and the need for the results of this study.

Planning and User Involvement

Two concepts repeated over and over in both the literature and the field responses and appearing throughout the study's model as key concepts are these:

1. **Planning** is a central element of the computer design process, used at practically every stage from developing a plan-to-plan at the beginning of the process, to the on-going planning that takes place as the computer system adapts and grows over time;

2. **User involvement** should be pervasive through the planning, implementation, and growth of the computer system. Many of the techniques submitted by respondents suggested ways to facilitate user acceptance of the computer system and methods to obtain user inputs to the design process.

These concepts are also very important to educational administration in general. The job of an administrator at any

level of management is often that of change agent. However, changes -- especially major ones -- are often difficult to successfully implement. The concepts of planning and user involvement were found to be essential for effectively changing manual operations into computerized applications. Use of these same concepts can help educational administrators promote other changes as well. There are many reasons why changes are unsuccessful and produce negative effects. Lack of planning and user involvement are two of those reasons. Macroscopic and microscopic planning, and inclusion in the process of those who will be affected, are key elements to efficiently and effectively making any change.

Computing Excitement

There appears to be more field enthusiasm over instructional computing than over administrative data processing. This observation is based upon the unsolicited submission of large amounts of sample documents by instructional respondents. No administrative respondents sent documents with their survey forms; materials were received from them only after verbal requests via telephone interviews.

The reason for this apparent difference in levels of enthusiasm may be related to the purpose of each type of computer system. Administrative computer systems accomplish support tasks; business and management computer applications aid the decision-making that affects instructional matters. However, instructional computer systems are related to the primary

function of a school, the teaching-learning process. Instructional computing serves the primary clients of a school: the pupils and those who have direct contact with them, the teachers. It may be difficult for the entire district to become enthusiastic about a more efficient method of performing general fund accounting. However, the staff, the students, and the entire community often become excited about ways of improving learning.

Need for the Results of the Study

Apparently, a genuine need exists for the results of this study. A review of the literature uncovered much related research, but little work directly addressing this topic; no comprehensive computer system model similar to this study's was found. This observation was confirmed by the field research. Practically all of the respondents from the nominator population and the school district populations requested copies of the results of the study. This may be the norm for participants of any research. However, many respondents from the school district populations wrote to express their concern about a great need for design guide-lines that practitioners can use. This was reinforced by conversations with members of the nominator population and school district populations. Furthermore, the high response rates of the school district populations may be a further indicator of the importance of this topic in the field.

FUTURE IMPLICATIONS

This section speculates on the future direction of electronic technology and implications for the design process.

Assumption 1: The Availability of New Products

Assumption

Computer technology will continue to advance, and new and better hardware, software, and peripherals will be ever-present in the marketplace.

Implications

The rapid pace of product design may mean that a new computer system is technologically obsolete by the time it is operationalized. This is not to imply that the system will not meet the needs for which it was designed; rather, more sophisticated equipment may be able to increase the efficiency and/or effectiveness of the system. This study found that the majority of changes to computer systems involve upgrades of and/or expansions to the system. With new products appearing in the marketplace at a fast pace, and the desire of designers to take advantage of these new inventions, the concepts of evaluation and adaptation may take on increasing importance in the design process.

Assumption 2: Data Storage and Access

Assumption

Advanced technology will enable more data to be centrally stored in a smaller physical space. Furthermore, increased networking capabilities will enable more users at various work

sites, including the home, to access these data.

Implications

The condensation of data storage and the increased ease of data access will bring more emphasis on security and confidentiality. It may be helpful for schools to work with government agencies and private industry for solutions to these problems. Because of the powerful mainframe computers often used in these organizations, they have already been forced to address some of these issues.

Greater networking capabilities may increase the number of users per system. This may put even more emphasis on the concept of user involvement in the design process.

Increased ease of electronic data transfer may reduce the necessity for person-to person contact. A model for computer system design must not ignore the need for human contact and socialization in the work place. There must still exist legitimate reasons for workers to interact, other than breaks and lunch periods. This implication is especially applicable to administrative computer systems. With classroom computing, teachers still interact with students; however, there must still exist opportunities for teachers to work with other teachers.

Assumption 3: Permanency of the Computer Revolution Assumption

Micro and mini computers are not fads; they are here to stay. They have found a legitimate place in schools, and

their numbers will continue to grow in districts of all kinds.

Implications

It appears that even districts that have been laggards in computer system adoption now admit that both administrative and instructional computer systems belong in schools. Computers are no longer considered modern frills solely for use in wealthy districts. Therefore, districts of every kind, are articulating needs that can be addressed by computer systems. To finance the purchase of these computers, monies must be obtained. In the future, a model for computer system design may place greater emphasis on the aggressive search for and procurement of funds.

To encourage the wide-spread use of instructional computer systems by staff, and to increase teachers' efficiency, there may be more emphasis on the use of applications software -- word processing, electronic spreadsheets, and data base management -- for teachers. The results of the survey indicated that this is currently done in some districts; however, there may be increased emphasis on this aspect of instructional computing in the future.

The preponderance of instructional computer systems will not mean the end of schools as we know them today. Schools and school buildings will always exist because of their custodial and socialization functions; however, the instructional delivery system may change. Computers provide teachers with the capacity to do more individualization of instruction. It

may be necessary for teachers to shift their emphasis from group lessons to more accommodation of individual pupil differences. This trend may be reflected in both curriculum development and training techniques. It may be necessary to teach potential users of an instructional computer system not only the operation of the system but also the pedagogy of individualization.

With the increased numbers and uses of computers in schools, job descriptions and hiring criteria may change. For example, one of the selection criteria for administrators, teachers, and office workers may be computing experience. Furthermore, when implementing a new computer system, there may be a few employees who cannot or will not accept or use the computer system. It may be necessary to deal with these individuals in a remedial or even disciplinary manner. These implications may mean an additional role for employee unions. Future versions of the model may reflect not only increased user involvement, but also union participation when the design and operation of a computer system would affect terms and conditions of employment.

SUMMARY

Using the concepts and practices contained in the model, educational administrators can plan and implement computer systems that are efficient, effective, and responsive to the needs of the school district and its people. A well-designed computer system can help a school work toward preferred fu-

tures by making the new technologies a help, rather than a hindrance.

APPENDIX A

THE PANEL OF EXPERTS

MEMBERS OF THE PANEL OF EXPERTS

Dr. Robert Binner
Superintendent of Schools
Cheektowaga-Maryvale Union Free School District
Cheektowaga, New York

Mr. Owen Bliven
Supervisor of Instructional Resources
Kenmore-Town of Tonawanda Public Schools
Kenmore, New York

Dr. Bruce Brummitt
Executive Director
New York State Association of School Business Officials
Albany, New York

Dr. Jack Helfrich
Superintendent of Schools
Kenmore-Town of Tonawanda Public Schools
Kenmore, New York

Dr. Hinrich Martens
Director
State University of New York at Buffalo Computing Services
Amherst, New York

Mr. Ralph Smith
School Business Manager
Starpoint Central School
Lockport, New York

Mr. Charles Solfrank
Sales Representative
Computer Systems Depew
Depew, New York

Mr. Ben Verrico
Senior Sales Representative
IBM Corporation
Buffalo, New York

APPENDIX B

AN INTRODUCTION TO COMPUTERS

COMPUTER SYSTEMS

A computer system is a functional unit consisting of hardware, peripherals, software, and users and can perform routine data processing or customized applications.

Computer Hardware

Hardware is the physical equipment of a computer system, including mechanical, electronic, and magnetic components such as wires, central processing unit chips, and motors.

There are three broad classifications of computer hardware: microcomputers (micros), minicomputers (minis), and mainframes. The lines of demarcation between these hardware types are becoming blurred because of rapid technological advancements. It is often difficult to categorize a particular machine. Many microcomputers, such as the IBM PC/AT, have the power of low-end minicomputers and are being used as such. Likewise, there are fewer differences between today's high-end minicomputers (super-minis) and mainframes; in fact, some minicomputers are considered personal mainframes.

Nevertheless, because this model concentrates on micros and minis, it is important to attempt definitions of the three classifications of computers. Definitions in the literature vary greatly, depending on the make of the machine, its intended purposes, and the orientation of the author. However, for the purposes of this guide, microcomputers, minicomputers, and mainframe computers are defined below.

Sources of information for these definitions include professional journals, computing magazines, and conversations with a panel of experts, whose members are knowledgeable about computer technology.

Mainframe Computers

Mainframe computers are often called large computers because of their price, size and power. They typically cost over $1 million and can occupy an entire room. Because of its power, a mainframe can serve hundreds of users simultaneously with an acceptable response time measured in seconds. It is necessary to hire a trained data processing staff to operate the computer, because its programs must be written in machine language. Furthermore, mainframes have a small range of comfort zones and often require special atmospheric conditions, such as air conditioning, for optimal functioning.

Minicomputers

Minicomputers comprise the most nebulous of the three categories. The best way to define them is to say that their characteristics lie somewhere between mainframes and micros. A minicomputer is smaller and can be less expensive than a mainframe, with a price range of $10,000 to $250,000. Powerful minis can accommodate up to 150 users simultaneously with respectable response time. While minis do not require a staff of data processing professionals for operation, their software is seldom purchased in computer stores, but rather is custom-made by the vendor.

Microcomputers

Microcomputers are the most affordable of the three types, with prices of $100 to $7,000. Micros are traditionally single-user machines; however, it is possible to have many micros working together in a network. It is also possible to electronically link microcomputers with minis or main-frames, enabling the user to centralize data storage in the larger machine while decentralizing data processing at the micro. Microcomputers have several advantages over the larger computers: improved price/performance, portability, and capabilities for color and graphic output. Micros are easy to use for individuals who have no prior training in data processing. Software is generally purchased "off-the-shelf" from computer stores or through mail; however, it is possible to use machine language to customize programs. Also, it is relatively easy to write software for micros using a programming language such as BASIC or Pascal.

Computer Peripherals

Peripherals are units separate from, but electronically attached to, a computer and allow communication to and from the computer. They can be classified as devices for input, output, and communication. Input peripherals include touch-sensitive screens, light beam pens, keyboards, and graphics tablets. Output peripherals include speech synthesizers, printers, and cathode ray tubes (CRTs). CRTs are also known as video display terminals (VDTs) or monitors and resemble

television screens. Communications peripherals, which can be used for both data input and output include the teletypewriter which is a combination of a keyboard and a printer, modems which enable the computer to send and receive data through phone lines, disk drives, and hard disks.

Computer Software

Software contains programs or instructions that direct the operations of computer hardware and peripherals to produce adesired output. Software can be purchased in three forms: (1) custom-made to the user's specifications; (2) commercially produced and available ("off-the-shelf" software); (3) "off-the-shelf" modified to meet the user's paticular needs. In addition to purchased software, free programs can be obtained from public domain libraries maintained by computer user groups.

COMPUTER SYSTEM CONFIGURATIONS

There are several ways to physically and electronically arrange the components of a computer system. A system can consist of stand-alone computers; this means that a single mini or micro can operate independently, perhaps connected only to some peripheral devices. One of the most promising and useful electronic configurations, however, is that of a network. Broadly defined, a network is a set of interconnected data processing equipment -- such as computers, printers, and/or terminals -- linked by communications lines such as computer cables or telephone lines. Electronic networks

can have several purposes:

1. **Sharing resources**, which allows many users to access the same printer or memory bank, eliminating the need for each work station to have its own printer or data storage device;

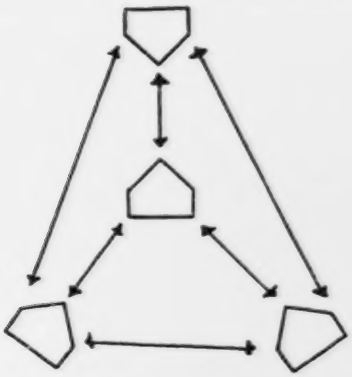
2. **Electronic transfer of data** among computers at different locations. This includes sending and receiving messages, memos, or letters, which is commonly termed electronic mail. With electronic mail, users can "talk" with one another through their computers. This communication can be intra- organizational or across school, state, and national boundaries;

3. **Data base information retrieval** gives users access to large banks of information stored in mainframe computers at remote locations. One promising use of this concept is electronic access to a wide variety of facts stored in public utility data banks.

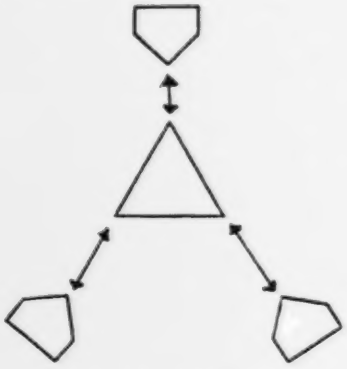
Networks can have several hardware configurations, depending upon the types of equipment used and the purposes desired. There are three basic kinds of multi-machine arrangements: the local area network, distributed data processing, and remote area data processing. James (1983) stated that because of the extensive communications capabilities among components of a local area network, this hardware configuration constitutes the only true definition of a network. In practice, however, the term "network" is often used to describe many types of multi-machine arrangements. Figure 2 illustrates the three hardware configurations for networks. The descriptions below are based on the work of James (1983).

Local Area Network (LAN)

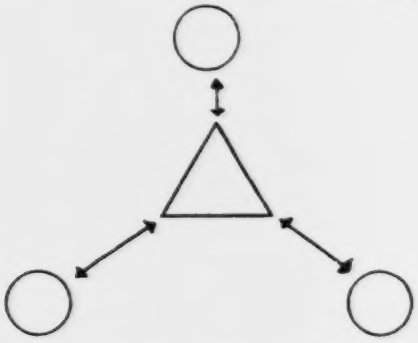
This hardware configuration may have the greatest potential because it offers the combined advantages of independence



Local Area Network



Distributed Data Processing



Remote Area Data Processing

KEY:

= Host computer (mainframe or minicomputer)

= Micro or mini computer with data processing capabilities

= Micro or mini computer acting as a dumb terminal which can only send and receive information

= Lines of electronic communication

Figure 2. Three Kinds of Hardware Configurations for Networks

and centralization. In this arrangement, inter-connected micros and/or minis have several functions. Any computer in the network, regardless of geographic placement, can access any other element of the network, be it hardware or peripherals. Each micro or mini in the network can act as a central processing unit for any and all other computers in the system, enabling each electronic work station to receive information from or send data to all other subsystems in the network. Each computer can function independently of the system, too.

Telecommunications are a promising use of local area networks. In this arrangement, computers communicate with each other via phone lines, using devices called modems which translate computer-readable digital data into telephone transmission frequency data and back again. Telecommunications can be used to send electronic mail and to hold audioconferences and meetings among participants located many miles apart.

Distributed Data Processing (DDP)

In this multi-user arrangement, micro or mini computers are electronically linked with a host computer, either a mini or a mainframe computer. Each user can access only the host computer; there is no inter-micro communication. However, users in this arrangement can access information from the host computer, independently process it to satisfy their unique needs, and either send it back to the host computer to be stored in central memory or store it on-site.

Remote Area Data Processing (RADP)

Sometimes called time-sharing or on-line processing, remote area data processing centralizes and controls computing operations. Unintelligent terminals -- or micros or minis acting as dumb terminals -- are linked with a host computer, which can be either a mainframe or a minicomputer. Using these dumb terminals, many simultaneous users can exchange data with the host computer; users are charged only for access time or data storage used and phone line costs. Independent manipulation of data bases and customized applications are not possible. Communication is restricted because individual users cannot interact with other computers in the system.

COMPUTER SYSTEM APPLICATIONS

School personnel require tools to sort, organize, store, retrieve, and update data. Computers can accomplish these tasks through a variety of applications. Kiser (1983) has classified computer system data processing into four categories relevant to education: computer assisted instruction (CAI), computer managed instruction (CMI), computer assisted administration (CAA), and computer assisted office work (CAO).

Computer Assisted Instruction (CAI)

With CAI, computers can augment the traditional teaching-learning process by providing students with concentrated, self-paced learning. In this context, a program is a lesson through which a student can work at his or her own pace. There are six major types of CAI software:

1. **Problem-solving software has the student solve problems related to specific concepts or subject areas. This is the software most used for CAI;**

2. **Drill and practice software gives the learner additional exposure to a previously taught concept. This type of CAI software is second in use to problem-solving programs;**

3. **Tutorial programs present a lesson and then test the learner's understanding of the material through review questions and feedback;**

4. **Simulation software teaches through the "discovery method:" The learner is presented with a real-life scenario to which he/she must respond; the learner also sees the results of those response decisions;**

5. **Testing software evaluates the student's knowledge of a particular area by asking a series of questions, similar to traditional paper-and-pencil examinations;**

6. **Games are used to improve problem-solving skills while making learning fun.**

The Electronic Revolution has also fostered a new subject area in schools: computer science. These courses vary in content from an emphasis on computer literacy -- which focuses on computer awareness, the effect computers have on daily life, and computer applications for work and home -- to teaching basic programming skills.

Computer Managed Instruction (CMI)

Using CMI, a teacher can individualize instruction through an evaluation of a student's performance, a diagnosis of his/her strengths and weaknesses, and a prescription for corrective measures. Specific CMI applications include:

1. **Curriculum development, including maintenance of regular and remedial subject matter data bases;**

2. **Resource management and scheduling,** including the coordination of teacher time, classroom usage, and library and audiovisual materials;

3. **Testing,** including item storage, test construction and scoring, item analysis, and reporting of results;

4. **Reports** and feedback to students and parents.

Computer Assisted Administration (CAA)

Computer assisted administration usually involves a computerized management information system (MIS) or a decision support system (DSS). The purpose of any MIS is to help administrators make better decisions, thereby increasing their efficiency and effectiveness. A computer-based MIS increases the power and scope of the traditional MIS because of ease of data maintenance and manipulation. A decision support system augments the MIS concept. A DSS uses data bases and forecasting models, such as time series and regression analyses, to aid the administrator in strategic planning. Specific applications for computer assisted administration include:

1. **Student applications:**

   a. Athletic eligibility lists;

   b. Extra-curricular activities lists and participants;

   c. Attendance reporting by building and district aggregate;

   d. Student and family district census;

   e. Enrollment projections by grade, school, and aggregate district;

   f. Class lists;

   g. Longitudinal studies on students;

h. Student and teacher master schedules;

i. Alumni follow-up surveys;

j. Records for pupil personnel, handicapped pupils, and special education;

k. Transportation routes;

l. Data banks on non-puplic schools;

m. Student needs, such as locker and lock assignments, bus passes, schedules, and lunch tickets;

n. Automobile registration and parking permits;

o. Library book cataloging and circulation;

p. Inventory of student supplies, such as books, equipment, and uniforms;

q. Behavior records;

r. Medical records;

s. Course history maintenance;

t. Management of adult education programs;

u. Report cards and progress reports;

v. Guidance records, student registration, and school transcripts;

2. Personnel:

a. Staff information: assignments, attendance, certification, course work and in-service training;

b. Staff observations and evaluations;

c. Negotiation and salary simulations;

d. Records for auxiliary personnel such as substitutes and student teachers;

e. Calendar generation and staff scheduling;

f. Projecting staffing needs;

3. **Finance:**

   a. Accounts payable and receivable;

   b. Accounting: fund, financial, cost, petty cash, and cash flow;

   c. General Ledger;

   d. Investments;

   e. State and federal reports;

   f. Purchasing;

   g. Food Service;

   h. Budget development, including revenue and expenditure forecasting;

   i. Budget control;

   j. Project planning;

   k. Public budget documents;

   l. Specification and analysis of bids and quotations.

   m. Computation of school tax levy;

   n. Payroll;

4. **Facilities:**

   a. Energy management and plant security;

   b. Inventory of supplies, equipment, and fixed assets;

   c. Plant utilization;

   d. Work orders;

   e. Schedules and reports for buildings and grounds maintenance;

   f. Warehousing;

   g. Accident reports;

h. Equipment status reports;

i. Gasoline usage for school buses;

j. Computer aided design;

Computer Assisted Office Work (CAO)

Computer systems in administrative offices facilitate clerical work. With micros or minis, secretaries can more easily store, retrieve, and maintain data, tabulate data into reports, and produce report documents. Some specific applications of CAO are:

1. School district publications or presentations;

2. Mailing lists and labels;

3. Correspondence, especially of a routine or repetitive nature;

4. Lists of names or objects which must be regularly updated;

5. In-house documents.

For computer managed instruction, computer assisted administration and computer assisted office work, there are several kinds of software that are widely used:

1. Word processing software is a text-editing tool useful for composing an original document, making changes in an existing one, or customizing form letters;

2. Electronic spreadsheet programs provide two-dimensional matrices that are used for calculations and for answering "what if..." questions. If a number in one cell of the matrix is changed, all values related to it will also change, making manual recalculations unnecessary;

3. Data base management software acts as an electronic file cabinet for the storage, retrieval, modification, and manipulation of data. Data are entered in

a defined format, and output is in the form of customized reports generated by the user. The user can also interact with the computer and ask questions about the data base;

4. **Integrated software** contains, on one disk, a number of programs -- such as an electronic spreadsheet, data base management software, and graphics capabilities -- which work together;

5. **Integrating software** allows data transfer between different kinds of programs not integrated on one disk.

APPENDIX C

SCHOOL VISITATION FORMS

SCHOOL VISITATION FORM

School District _____

Name of School _____

Address _____

_____

Contact Person Name _____ Phone _____

Title _____

Date of Visit _____

Names of Observers _____

1. SCHOOL DISTRICT DESCRIPTION

a. Number of district schools _____
b. Number of: Students _____
Administrators _____
Teachers _____
Clerical staff _____
c. Amount of school district budget $_____

2. COMPUTER SYSTEM DESCRIPTION

a. Length of system operation: _____
b. Number of users: Students _____
Administrators _____
Teachers _____
Clerical staff _____
c. Applications and Software

_____	____	_____
_____	____	_____
_____	____	_____
_____	____	_____
_____	____	_____
_____	____	_____

d. Description of hardware:

e. Description of peripherals:

f. Description of networking configurations:

g. Recommended vendors:

Purpose of Vendors	Company Information:
Purpose _____	Name _____
_____	Address _____
_____	_____
_____	Phone _____
_____	Contact person _____
Purpose _____	Name _____
_____	Address _____
_____	_____
_____	Phone _____
_____	Contact person _____
Purpose _____	Name _____
_____	Address _____
_____	_____
_____	Phone _____
_____	Contact person _____
Purpose _____	Name _____
_____	Address _____
_____	_____
_____	Phone _____
_____	Contact person _____

h. Methods of user training:

i. Description of computer system facilities:

3. PLANNING

a. User satisfaction with system:

b. User dissatisfaction with system:

c. Future system plans:

d. Planning advice:

APPENDIX D

NEEDS ASSESSMENT FORMS

INSTRUCTIONAL NEEDS ASSESSMENT SURVEY

Date: _____

This survey is being conducted to determine staff background and interest in using computers. Please answer the following questions directly on this form and return it to _____

_____

by _____ .

THANK YOU FOR YOUR COOPERATION.

Name (Optional) _____

School _____

Grade(s) _____

Subject(s) _____

Number of years in education _____

SECTION I: COMPUTING BACKGROUND

Directions: In this section you are asked some questions about your previous experience with computers. For each question, CIRCLE YES or NO to indicate your answer.

Q-1. Have you ever used a computer? YES NO

Q-2. Do you have a computer in your home? YES NO

IF YES, what brand/model is it? _____

SECTION II: COMPUTER APPLICATIONS

Directions: Computers can perform many different tasks. Questions in this section ask about computer applications with which you have had some experience and applications you would like to use in your classroom. For each statement, circle YES or NO in the EXPERIENCE column to indicate if you have had prior experience using that application. Then circle YES or NO in the INTEREST column to indicate if you would like to use that application in your classroom.

REMEMBER: Circle YES or NO in BOTH COLUMNS.

Q-3. Applications for student use:	EXPERIENCE Have you previously used this application?		INTEREST Are you interested in using this application?	
Drill and practice exercises	YES	NO	YES	NO
Problem-solving exercises	YES	NO	YES	NO
Simulation exercises	YES	NO	YES	NO
Individual tutoring	YES	NO	YES	NO
Educational games	YES	NO	YES	NO
Computer science	YES	NO	YES	NO
Computer graphics	YES	NO	YES	NO

	EXPERIENCE Have you previously used this application?		INTEREST Are you interested in using this application?	
Word processing	YES	NO	YES	NO
Spreadsheet (numeric) calculations	YES	NO	YES	NO
Data base/file management	YES	NO	YES	NO
Programming	YES	NO	YES	NO
Applications for business	YES	NO	YES	NO
Applications for industry	YES	NO	YES	NO
Applications for engineering	YES	NO	YES	NO
Societal impact of computers	YES	NO	YES	NO
Other: _____	YES	NO	YES	NO

Q-4. Applications for teacher use:

Word processing	YES	NO	YES	NO
Spreadsheet (numeric) calculations	YES	NO	YES	NO
Data base/file management	YES	NO	YES	NO
Computer graphics	YES	NO	YES	NO
Test administration	YES	NO	YES	NO
Test scoring	YES	NO	YES	NO
Curriculum development	YES	NO	YES	NO
Resource management/scheduling	YES	NO	YES	NO
Report generation	YES	NO	YES	NO
Other: _____	YES	NO	YES	NO

SECTION III: COMPUTER IMPLEMENTATION

Directions: These questions ask your input on certain aspects of computer implementation. Please follow the directions for each question.

Q-5. If computers were to be placed in your building, where would you like to see them located? (Rank order the choices below, using a "1" for your first choice location, a "2" for your second choice location, etc., using a "6" for the least desirable location.

_____ Permanently located in a computer lab
_____ Permanently located in the library
_____ Permanently located in classrooms
_____ Portable computers
_____ Combination of the above
_____ Other: _____

Q-6. If computers were to be placed in your building, what kind of training would you need to use them? (Check one.)

_____ NONE (I am a computer expert and may even be willing to act as a trainer.)
_____ ADVANCED (I know a great deal about computers but would like to learn more.)
_____ INTERMEDIATE (I have some computing experience, but need additional training.)
_____ BEGINNING (I have little or no experience with computers.)

Is there anything else you would like to mention about instructional computing? If so, please use this space for that purpose.

Your contribution to this survey is very greatly appreciated.

ADMINISTRATIVE NEED ASSESSMENT SURVEY

Date: _____

This survey is being conducted to determine staff background and interest in using computers. Please answer the following questions directly on this form and return it to _____

_____

by _____ .

THANK YOU FOR YOUR COOPERATION.

Name (Optional) _____

School _____

Position _____

Number of years in that position _____

SECTION I: COMPUTING BACKGROUND

Directions: In this section you are asked some questions about your previous experience with computers. For each question, CIRCLE YES or NO to indicate your answer.

Q-1. Have you ever used a computer? YES NO

Q-2. Do you have a computer in your home? YES NO

IF YES, what brand/model is it? _____

SECTION II: COMPUTER APPLICATIONS

Directions: Computers can perform many different tasks. Questions in this section ask about computer applications with which you have had some experience and applications you would like to use on your job. For each statement, circle YES or NO in the EXPERIENCE column to indicate if you have had prior experience using that application. Then circle YES or NO in the INTEREST column to indicate if you would like to use that application on your job.

REMEMBER: Circle YES or NO in BOTH COLUMNS.

Q-3. Computerized finance applications:	EXPERIENCE Have you previously used this application?		INTEREST Are you interested in using this application?	
Accounts payable and receivable	YES	NO	YES	NO
Fund accounting	YES	NO	YES	NO
Cash flow analysis	YES	NO	YES	NO
General ledger	YES	NO	YES	NO
Investments	YES	NO	YES	NO
State and federal reports	YES	NO	YES	NO
Purchasing	YES	NO	YES	NO

	EXPERIENCE Have you previously used this application?		INTEREST Are you interested in using this application?	
Food service records	YES	NO	YES	NO
Budget development	YES	NO	YES	NO
Budget control	YES	NO	YES	NO
Project planning	YES	NO	YES	NO
Public budget documents	YES	NO	YES	NO
Bid analysis	YES	NO	YES	NO
Computation of school tax	YES	NO	YES	NO
Payroll	YES	NO	YES	NO
Other: _____	YES	NO	YES	NO
Q-4. Computerized personnel applications:				
Staff information and records	YES	NO	YES	NO
Staff observations/evaluation records	YES	NO	YES	NO
Negotiations and salary simulations	YES	NO	YES	NO
Staff scheduling	YES	NO	YES	NO
Calendar generation	YES	NO	YES	NO
Projections of staffing needs	YES	NO	YES	NO
Other: _____	YES	NO	YES	NO
Q-5. Computerized facilities applications:				
Energy management	YES	NO	YES	NO
Plant security	YES	NO	YES	NO
Inventory	YES	NO	YES	NO
Plant utilization	YES	NO	YES	NO
Work orders	YES	NO	YES	NO
Building maintenance schedules	YES	NO	YES	NO
Building maintenance reports	YES	NO	YES	NO
Warehousing	YES	NO	YES	NO
Accident reports	YES	NO	YES	NO
Equipment status reports	YES	NO	YES	NO
Gasoline usage for school buses	YES	NO	YES	NO
Computer aided design	YES	NO	YES	NO
Other: _____	YES	NO	YES	NO
Q-6. Computerized student applications:				
Athletic eligibility lists	YES	NO	YES	NO
Extra-curricular activity lists	YES	NO	YES	NO
Attendance reporting	YES	NO	YES	NO
School district census	YES	NO	YES	NO
Enrollment projections	YES	NO	YES	NO
Class lists	YES	NO	YES	NO
Longitudinal studies on students	YES	NO	YES	NO
Student master schedules	YES	NO	YES	NO
Teacher master schedules	YES	NO	YES	NO
Alumni follow-up surveys	YES	NO	YES	NO
Pupil personnel records	YES	NO	YES	NO
Transportation routes	YES	NO	YES	NO
Data banks on non-public schools	YES	NO	YES	NO
Student needs (lockers, bus passes, etc.)	YES	NO	YES	NO

	EXPERIENCE Have you previously used this application?		INTEREST Are you interested in using this application?	
Parking permits and car registration	YES	NO	YES	NO
Library book circulation	YES	NO	YES	NO
Library book cataloging	YES	NO	YES	NO
Inventory of student supplies	YES	NO	YES	NO
Behavior records	YES	NO	YES	NO
Medical records	YES	NO	YES	NO
Course history maintenance	YES	NO	YES	NO
Adult education program records	YES	NO	YES	NO
Report cards	YES	NO	YES	NO
Progress reports	YES	NO	YES	NO
Guidance records	YES	NO	YES	NO
School bus scheduling	YES	NO	YES	NO
Other: _____	YES	NO	YES	NO

Q-6. Computerized general applications:

Word processing	YES	NO	YES	NO
Spreadsheet (numeric) calculations	YES	NO	YES	NO
Data base/file management	YES	NO	YES	NO
Computer graphics	YES	NO	YES	NO
Other: _____	YES	NO	YES	NO

SECTION III: COMPUTER IMPLEMENTATION

Directions: These questions ask your input on certain aspects of computer implementation. Please follow the directions for each question.

Q-7. If computers were to be placed in your building, where would you like to see them located? (Rank order the choices below, using a "1" for your first choice location, a "2" for your second choice location, etc., using a "5" for the least desirable location.

_____ Permanently located in a centralized location
_____ Permanently located at the user's work station
_____ Portable computers
_____ Combination of the above
_____ Other: _____

Q-8. If computers were to be placed in your building, what kind of training would you need to use them? (Check one.)

_____ NONE (I am a computer expert and may even be willing to act as a trainer.)
_____ ADVANCED (I know a great deal about computers but would like to learn more.)
_____ INTERMEDIATE (I have some computing experience, but need additional training.)
_____ BEGINNING (I have little or no experience with computers.)

Is there anything else you would like to mention about administrative computing? If so, please use this space for that purpose.

Your contribution to this survey is very greatly appreciated.

APPENDIX E

PRODUCT ANALYSIS CHART

The Product Analysis Chart is a decision-making tool to aid the analysis of alternativesand the selection of material inputs to a computer system. It is adapted from the Instructional Systems Analytical Study (ISAS) in the Western New York Planning-Programming-Budgeting System (Murphy, Kiser, & Ambrosie, 1972, p. ISAS-101).

Directions for use: Follow along with two Product Analysis Charts. One is completed to illustrate the directions; the other is blank for use by computer system planners.

PRODUCT ANALYSIS CHART:

DIRECTIONS FOR USE

1. In the space marked, "Product," write the computer system component being analyzed (software, hardware, printer, hard disk, vendor, etc.);

2. In the area labeled, "Alternatives," assign a letter to each brand being examined;

3. In the column labeled, "Specification," write the selection criteria developed earlier for that product in order of importance, the most important specification being first and the least important specification being last;

4. In the column labeled "Weight," assign a number to each specification. The weights should reflect the priorities among specifications. The higher the number, the more important the specification. It is possible, then, for one specification to have a much higher weighting than the specification directly below it. It is also possible for two specifications to have identical weightings;

5. In the column labeled, "Value," write descriptors and values that reflect the degree to which a product can meet that specification. Choose words that make sense, but keep the same weights for each set of values. A value scheme of 3, 2, and 1 works well, where a "3" represents a product that definitely meets the specification and a "1" represents a product that does not meet the selection criterion;

6. Determine how well the product meets each of the specifications. Then multiply the weight of that specification by the value which describes how well the product meets that specification. Write that number in the column for that alternative. Do this for each product alternative and for each specification;

7. Total the scores for each alternative. This results in a total score for each product. The highest score represents the brand that best meets the selection criteria.

PRODUCT ANALYSIS CHART
(SAMPLE)

PRODUCT: PRINTERS **DATE:** 6/1/86

ALTERNATIVES: A = BRAND A D = BRAND D

B = BRAND B E = _____

C = BRAND C F = _____

SPECIFICATION	WEIGHT	VALUE	ALTERNATIVE					
			A	B	C	D	E	F
1. QUALITY OF OUTPUT	10	3-LETTER-QUALITY 2-CORRESPOND. 1-DOT MATRIX	30	30	20	10		
2. CAPACITY FOR: UNDERLINING BOLDFACE SUPER/SUB SCRIPT	9	3-DOES ALL 3 2-DOES 2 OUT OF 3 1-DOES 0 OR 1 OUT OF 3	27	18	18	18		
3. PRINT STYLES	8	3-MANY INC. VARIOUS PITCHES 2-SEVERAL 1-FEW	16	24	16	24		
4. WIDE CARRIAGE (≥ 11½ INCHES)	7	2-YES 1-NO	14	14	14	7		
5. DURABLE CONSTRUCTION	5	3-VERY STURDY 2-DURABLE 1-FLIMSY	15	15	10	5		
6. SPEED	4	3-≥ 100 CPS 2-30-100 CPS 1-≤ 30 CPS	12	4	8	12		
7. PRICE	3	3-≤ $1,000 2-$1,000-$2,000 1-≥ $2,000	3	6	6	9		
8.								
TOTAL SCORE			117	111	92	85		
			A	B	C	D	E	F

PRODUCT ANALYSIS CHART

PRODUCT: _____ **DATE:** _____

ALTERNATIVES: A = _____ D = _____

B = _____ E = _____

C = _____ F = _____

SPECIFICATION	WEIGHT	VALUE	ALTERNATIVE					
			A	B	C	D	E	F
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
TOTAL SCORE								
			A	B	C	D	E	F

APPENDIX F

SOFTWARE EVALUATION FORMS

INSTRUCTIONAL SOFTWARE EVALUATION FORM

Program title: _____ Cost: $_____

Publisher & address: _____

_____

_____

Compatible hardware: _____ Required memory: _____ K
(brand/model) (RAM)

Required peripherals (Check as many as apply):

- ☐ Joy stick
- ☐ Paddles
- ☐ Printer
- ☐ Color Monitor
- ☐ Other: _____

Subject (Check one):

- ☐ Pre-school
- ☐ Careers
- ☐ Critical thinking
- ☐ Art
- ☐ Computer science
- ☐ Foreign language
- ☐ Health
- ☐ Language
- ☐ Library science
- ☐ Math
- ☐ Music
- ☐ Science
- ☐ Social studies
- ☐ Other: _____

Topics covered (give description): _____

_____

_____

_____

_____

_____

Grade level (Check as many as apply):

- ☐ Pre-K
- ☐ K
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10
- ☐ 11
- ☐ 12

Type of application (Check one):

- ☐ Problem-solving
- ☐ Drill and practice
- ☐ Tutorial
- ☐ Simulation
- ☐ Testing
- ☐ Game

Intended user group (Check as many as apply):

☐ Individual ☐ Small group ☐ Class

Duration: _____ minutes

This program is to be used (Check one):

☐ alone ☐ as part of a series.

If this program is part of a series, please describe the series below:

_____

_____

_____

DIRECTIONS: Please evaluate the software by reacting to the following statements, which are positively worded and are accompanied by five point scales to indicate the degree to which you agree or disagree with each of the statements. If you **strongly agree** with a statement, **CIRCLE** the number 5 on the corresponding scale. If you **strongly disagree** with the statement, **CIRCLE** the number 1 on the corresponding scale. You may express intermediate degrees of agreement by circling any number from 2 to 4. If the statement does not apply, circle NA. Please be sure to mark each scale only one time.

	Strongly Disagree				Strongly Agree	Does Not Apply
The software program:						
1. Is user-friendly.	1	2	3	4	5	NA
2. Has written documentation which is clear and understandable.	1	2	3	4	5	NA
3. Has clear on-screen directions.	1	2	3	4	5	NA
4. Displays text in an easy-to-read format.	1	2	3	4	5	NA
5. Has a user-controlled pace.	1	2	3	4	5	NA
6. Has on-screen menus to help the user.	1	2	3	4	5	NA
7. Is easy to enter and exit.	1	2	3	4	5	NA
8. Is free of bias and content errors.	1	2	3	4	5	NA
9. Is interesting and motivating.	1	2	3	4	5	NA
10. Is appropriate for the indicated grade level(s).	1	2	3	4	5	NA
11. Uses branches to clarify material.	1	2	3	4	5	NA
12. Uses branches for additional drill or tutoring.	1	2	3	4	5	NA
13. Uses graphics in an appropriate manner.	1	2	3	4	5	NA
14. Uses sound in an appropriate manner.	1	2	3	4	5	NA

	Strongly Disagree				Strongly Agree	Does Not Apply
15. Uses color in an appropriate manner.	1	2	3	4	5	NA
16. Makes effective use of the computer's capabilities.	1	2	3	4	5	NA
17. Incorporates appropriate learning theories.	1	2	3	4	5	NA
18. Helps meet curricular objectives.	1	2	3	4	5	NA
19. Presents material in a logical manner.	1	2	3	4	5	NA
20. Is responsive and uses positive reinforcement.	1	2	3	4	5	NA
21. Is free of programming errors.	1	2	3	4	5	NA
22. Has adequate provisions for warranties, corrections, and new version updates.	1	2	3	4	5	NA
23. I recommend this program.	1	2	3	4	5	NA

ADDITIONAL COMMENTS: _____

_____

_____

_____

_____

Reviewer's name: _____ Date: _____

Reviewer's school: _____

ADMINISTRATIVE SOFTWARE EVALUATION FORM

Program title: _____ Cost: _____

Publisher & address: _____

_____

_____

Compatible hardware: _____ Required memory: _____ K
(brand/model)

Required peripherals (Check as many as apply):

- ☐ Color monitor
- ☐ Dot matrix printer
- ☐ Modem
- ☐ Other: _____

Type of software program (check one):

- ☐ Word processing
- ☐ Electronic spreadsheet
- ☐ Data base management
- ☐ Other: _____
- ☐ Communications
- ☐ Graphics
- ☐ Integrated

If this is an integrated software package, list the types of programs it contains: _____

_____

_____

Can this program be intergrated/used with other software packages? (Check one)

- ☐ No
- ☐ Yes

If yes, list those software packages here: _____

_____

_____

DIRECTIONS: Please evaluate the software by reacting to the following statements, which are positively worded and are accompanied by five point scales to indicate the degree to which you agree or disagree with each of the statements. If you **strongly agree** with a statement, **CIRCLE** the number 5 on the corresponding scale. If you **strongly disagree** with the statement, **CIRCLE** the number 1 on the corresponding scale. You may express intermediate degrees of agreement by circling any number from 2 to 4. If the statement **does not apply, CIRCLE** NA. Please be sure to mark each scale only one time.

	Strongly Disagree				Strongly Agree	Does Not Apply
The software program:	1	2	3	4	5	NA
1. Is user-friendly.	1	2	3	4	5	NA
2. Has written documentation which is clear and understandable	1	2	3	4	5	NA
3. Displays text in an easy-to-read format.	1	2	3	4	5	NA
4. Has clear on-screen directions.	1	2	3	4	5	NA
5. Has a user-controlled pace.	1	2	3	4	5	NA
6. Has on-screen menus to help the user.	1	2	3	4	5	NA
7. Is easy to enter and exit.	1	2	3	4	5	NA
8. Requests uniform input by the user.	1	2	3	4	5	NA
9. Is tolerant of user errors.	1	2	3	4	5	NA
10. Is free of programming errors.	1	2	3	4	5	NA
11. Has adequate provisions for warranties, corrections, and new version updates.	1	2	3	4	5	NA
12. Meets the needs of the users.	1	2	3	4	5	NA
13. I recommend this program.	1	2	3	4	5	NA

Please react to the following statements **only** if the program has WORD PROCESSING capabilities:

The word processing function:						
1. Can generate mailing lists and labels.	1	2	3	4	5	NA
2. Can add and delete text.	1	2	3	4	5	NA
3. Can work with split screens.	1	2	3	4	5	NA
4. Can work with selected parts of the document.	1	2	3	4	5	NA
5. Can merge text files.	1	2	3	4	5	NA
6. Is compatible with grammar and spelling checkers.	1	2	3	4	5	NA
7. Has user-defined function keys.	1	2	3	4	5	NA
8. Can automatically hyphenate words at the end of a line.	1	2	3	4	5	NA
9. Can underline text.	1	2	3	4	5	NA
10. Can boldface text.	1	2	3	4	5	NA
11. Has a screen display of a full page of text with 80-column lines.	1	2	3	4	5	NA
12. Has a screen display showing page breaks.	1	2	3	4	5	NA
13. Has a screen display showing text as it will be printed.	1	2	3	4	5	NA
14. Has an automatic carriage return.	1	2	3	4	5	NA
15. Has a right-justification option.	1	2	3	4	5	NA

	Strongly Disagree				Strongly Agree	Does Not Apply

Please react to the following statements **only** if the program has ELECTRONIC SPREADSHEET capabilities.

The electronic spreadsheet function:

1. Has an adequate number of cells.	1	2	3	4	5	NA
2. Can provide for printer output.	1	2	3	4	5	NA
3. Has split-screen capabilities.	1	2	3	4	5	NA
4. Provides for easy changing of numerical entries and formulas.	1	2	3	4	5	NA

Please react to the following statements only if the program has DATA BASE MANAGEMENT capabilities.

The data base management function:

1. Has an adequate number of fields, records, and files.	1	2	3	4	5	NA
2. Provides for easy editing of data.	1	2	3	4	5	NA
3. Can provide meaningful inquiry about data bases.	1	2	3	4	5	NA
4. Can report information in a user-defined format.	1	2	3	4	5	NA
5. Can provide for screen or printer output.	1	2	3	4	5	NA

ADDITIONAL COMMENTS: _____

_____

_____

_____

Reviewer's name: _____ Date: _____

Reviewer's school: _____

APPENDIX G

SOFTWARE INVENTORY FORM

SOFTWARE INVENTORY

Date: _____

SUBJECT	GRADE LEVEL(S)	PROGRAM TITLE	PUBLISHER	HARDWARE BRAND	MEMORY REQUIRED	TYPE OF PROGRAM										
						Drill & Practice	Tutorial	Problem Solving	Simulation	Game	Test/Quiz	Word Processing	Electronic Spreadsheet	Data Base Management	Graphics	

APPENDIX H

SELECTED AND ANNOTATED BIBLIOGRAPHY

SELECTED AND ANNOTATED BIBLIOGRAPHY

The following publications provided ideas for the model and can be used as sources of information about the topics indicated.

General Systems Theory Concepts:

Immegart, Glenn L., & Pilecki, Francis J. An introduction to to systems for the educational administrator. Reading, Massachusetts: Addison-Wesley Publishing Company, 1973. This also provided ideas about planning concepts.

Planning Concepts and Practices:

Ackoff, Russell L. A concept of corporate planning. New York: Wiley-Interscience, 1970. This was also a source of evaluation and adaption concepts.

Bahniuk, Margaret Hilton. More than just a word processor. American School and University, 1983, 56(1), 42, 44, 46, 48, 50, 53. This publication and the next were the source of definitions of the various hardware network configurations.

James, David. Networking: a powerful tool for personal communication. Personal Computing, January 1983, pp. 46-54; 177.

Peat, Marwick, Mitchell & Co. An educational planning and evaluation guide for California School Districts. Sacramento, California: State of California Department of Education, 1972.

Steiner, George A. Strategic planning. New York: The Free Press, a division of Macmillan Publishing Co., Inc., 1979.

Computer System Design Concepts:

FitzGerald, Jerry, FitzGerald, Ardra F., & Stallings, Jr., Warren D. Fundamentals of systems analysis. New York: John Wiley & Sons, 1981.

Klein, Joel Michael. Development of a model for a computerized management information system for handicapped pupils (Doctoral Dissertation, New York University, 1982). Dissertation Abstracts International, 1982, 43, 1772A. (University Microfilms No. ADG82-26806)

Watson, Hugh J., & Carroll, Archie B. Computers for business: A managerial emphasis. Dallas, Texas: Business Publications, Inc., 1980.

Computer System Definitions:

Bird, Pristen, Dempsey, Bill, Detjen, Ted, Finkle, Leroy, & Pogrow, Stanley. Tracking down the "right" computer. Electronics Learning, 1984, 3(4), 39-49. This provided definitions related to computer literacy.

Graham, Carolyn. A glossary of microcomputer terms. In Frederick L. Dembowski (Ed.), Administrative uses for microcomputers, Volume 2: Hardware. Park Ridge, Illinois: The Research Corporation of the Association of School Business Officials of the United States and Canada, 1983. This and the Thompson article were used for definitions of computer peripherals.

Kiser, Chester. Strategic planning of school district small computer systems. Paper presented at the Twenty-First Annual convention of the Association for Educational Data Systems, Portland, Oregon, May 9-13, 1983. Published in Association for Educational Data Systems (AEDS) twenty-first annual convention proceedings. Washington, D. C. AEDS, 1983. This paper yielded categories for and definitions of four kinds of computerized applications.

Thompson, Barbara J. Computers in reading: a review of applications and implications. Educational Technology, 1980, 20(8), 38-41.

Want to Buy a Computer? Independent School, 1982, 41(4), 39-44. This article was useful for definitions of computer software.

Concepts Relating to the Change Process:

Havelock, R. G. The change agent's guide to innovation in education. Englewood Cliffs, New Jersey: Educational Technology Publications, 1973.

Hall, Gene E. Issues related to the implementation of computers in classrooms. Journal of Computers in Mathematics and Science Teaching, 1981, 1(2), 14-19.

Morgan, John S. Managing change. New York: McGraw-Hill Book Company, 1972.

Ergonomic Practices:

Calhoun, Lawrence. On computers: VDT's through rose colored glasses. American School and University, 1984, 56(5), 16.

Miller, R. Bruce. Radiation, ergonomics, ion depletion, and VDTs: healthful use of video display terminals. Information Technology and Libraries, 1983, 2, 151-158.

Design of Forms used in this Guide:

Murphy, John, Kiser, Chester, & Ambrosie, Frank. Western New York Planning-Programming-Budgeting System, self-instructional lessons and performance guides. Buffalo, New York: Erie County Board of Cooperative Educational Services, No. 1, 1972 (WNY PPBS Model, Vol. 2). (ERIC Document Reproduction Service No. ED 066 832) The format and procedures of the Product Analysis Chart (Appendix E) were adapted from the the Instructional Systems Analytical Study (ISAS) contained in the above publication.

Weis, Lynn. A microcomputer-based survey for selecting microcomputers. In Frederick L. Dembowski (Ed.), Administrative uses for microcomputers, Volume 2: Hardware. Park Ridge, Illinois: Research Corporation of the Association of School Business Officials of the United States and Canada, 1983. Ideas contained in materials of the Corporation for Public Information in Education, cited in the Weis publication, contributed to the development of the Needs Assesment Forms (Appendix D).

SELECTED SCHOOL DISTRICT REFERENCES

All one hundred school districts involved in the study contributed to the model through their survey results. However, the following districts were the source of specific design practices that were incorporated into the guide. These practices were submitted through written comments on the survey questionnaire, materials sent along with the completed questionnaire, and telephone interviews.

School District #12 Adams County, 11285 Highline Drive, Northglenn, Colorado 80233. Contact person: John Ackelson, Executive Director of MIS.

Albion Central School District, 324 East Avenue, Albion, New York 14411. Contact person: James Wood, Director of School Business and Finance.

Broward County Schools, 1300 West Las Olas Boulevard, Fort Lauderdale, Florida 33312. Contact person: Bruce Collins, Director of Systems and Programming.

Charlotte-Mecklenburg Schools, PO Box 30035, Charlotte, North Carolina, 28230. Contact person: Robert C. Hanes, Deputy Superintendent of Schools.

Chittenden Central School District, 7 Meadow Terrace, Essex Junction, Vermont 05452. Contact person: David Cozzens, Computer Coordinator.

Commack Union Free School District, PO Box 150, Commack, New York 11725. Contact person: Dr. Dolores Shanahan, Coordinator of Computer Education. Materials from Commack Union Free School District provided input for this guide's School Visitation Form (Appendix C) and Software Evaluation Forms (Appendix F).

Community Consolidated School District 181, 950 South Oak Street, Hinsdale, Illinios 60521. Contact person: Mary Ellen Madden, Computer Coordinator and Principal of the Oak School.

Concord-Carlisle Regional School District, 120 Meriam Road, Concord, Massachusetts 01742. Contact person: Carolee Matsumoto, Assistant Superintendent.

East Windsor Regional School District, 384 Stockton Street, Highstown, New Jersey 08520. Contact person: Charles F. Galbrait, Director of Finance.

Euclid City Schools, 651 East 222 Street, Euclid, Ohio 44123. Contact person: Lowell B. Davis, Treasurer.

Fairfax County Public Schools, 4414 Holborn Avenue,Annandale, Virginia, 22003. Contact person: Marvin Koontz, Director of Institutional Technology.

SchoolDistrict of Fort Atkinson, 317 South High Street, Fort Atkinson, Winsconsin 53538. Contact person: Ardell L. Wiederhoeft, Business Manager.

Hopewell Valley Regional School District, 425 South Main Street, Bennington, New Jersey 08534. Contact person: Theodore R. Johnson, Data Processing Manager. Materials from Hopewell Valley Regional School District provided input for this guide's School Visitation Form (Appendix C), Needs Assessment Forms (Appendix D), and Software Evaluation Forms (Appendix F).

Jefferson County Public Schools, 1209 Quail Street, Lakewood, Colorado 80215. Contact person: Dr. Jan W. Bybee, Program Manager of the Computer Science Department.

Kenmore-Town of Tonawanda Union Free School District, 1500 Colvin Boulevard, Kenmore, New York 14223. Contact person: Owen R. Bliven, Supervisor of Instructional Resources.

School District of Lancaster, 225 West Orange Street, Lancaster, Pennsylvania 17603. Contact person: John P. O'Haren, Data Processing Manager.

Lyons Township High School, 100 South Brainard, La Grange, Illinois 60525. Contact person: Donald Childs, Assistant Principal of the North Campus. Materials submitted by Lyons Township High School provided input for the model's Software Inventory Form (Appendix G).

Mahopac Central School District, Lakeview Drive, Mahopac, New York 10541. Contact persons: Amy Botto, Computer Coordinator: K-12 and Phillip B. Fredenburg, Assistant Superintendent for Business and Financial Affairs.

Medford School District 549C, 500 Monroe Street, Medford, Oregon 97501. Contact person: Jerry L. Anderson, Supervisor of Data Processing.

Metropolitan School District of Washington Township, 3801 East 79th Street, Indianapolis, Indianna 46240. Contact person: Edwin E. Rump, Assistant Superintendent of Schools.

Montgomery County Public Schools, 850 Hungerford Drive, Rockville, Maryland 20850. Contact person: Stephen M. Raucher, Director of the Department of MIS and Computer Services.

Newburg School District 29, Jt., 1421 Deborah Road, Newburg, Oregon 97132. Contact person: Lewis M. Rees, Business Manager.

Ramsey Public Schools, 226 East Main Street, Ramsey, New Jersey 07446. Contact person: David L. Rinderknecht, Assistant Superintendent for Business.

Ridgeland Public Schools, District 122, 6500 West 95th Street, Oak Lawn, Illinois 60453. Contact person: Dr. Donald R. Johnson, Assistant Superintendent.

Rockland School District, 111 East North Street, Eureka, Missouri 63025. Contact person: Geoffrey H. Smith, Director of Data Processing.

Roselle Public Schools, 710 Locust Street, Roselle, New Jersey 07203. Contact person: Dr. R. Gregory Quirk, School Business Administrator.

Seminole County Public School System, 1211 South Mellonville Avenue, Sanford, Florida 32779. Contact person: Gary Becker, Director of Media Services. Material from the Seminole County Public School System provided input for the Software Evaluation Forms (Appendix F).

Shakopee Public Schools, 1137 Marschall Road, Shakopee, Minnesota 55379. Contact person: Ronald E. Ward, Technology Director.

Spencerport Central Schools, 71 Lyell avenue, Spencerport, New York 14559. Contact person: Robert E. Sudlow, Assistant Superintendent for Instruction.

Taft Union High School District, Seventh and San Emidio Streets, Taft, California 93268. Contact person: Gerald P. Dragoo, Director of Computer Services and Staff Development.

Wake County Public Schools, 2302 Noble Road, Raleigh, North Carolina 27611. Contact person: William Ruchte, Computer Instruction Consultant.

Weston Public Schools, 89 Wellesley Street, Weston, Massachusetts 02193. Contact person: Dr. Gus Sayer, Assistant Superintendent for Curriculum. Materials from Weston Pub-

lic Schools provided input for the model's Needs Assessment Forms (Appendix D).